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Water Operations Technical Support Program

WESTEX: A Numerical, One-Dimensional Reservoir Thermal Model

Report 1
User's Manual

Edited by Darrell G. Fontane
Colorado State University

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Hydraulics Laboratory

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Report 1 of a series

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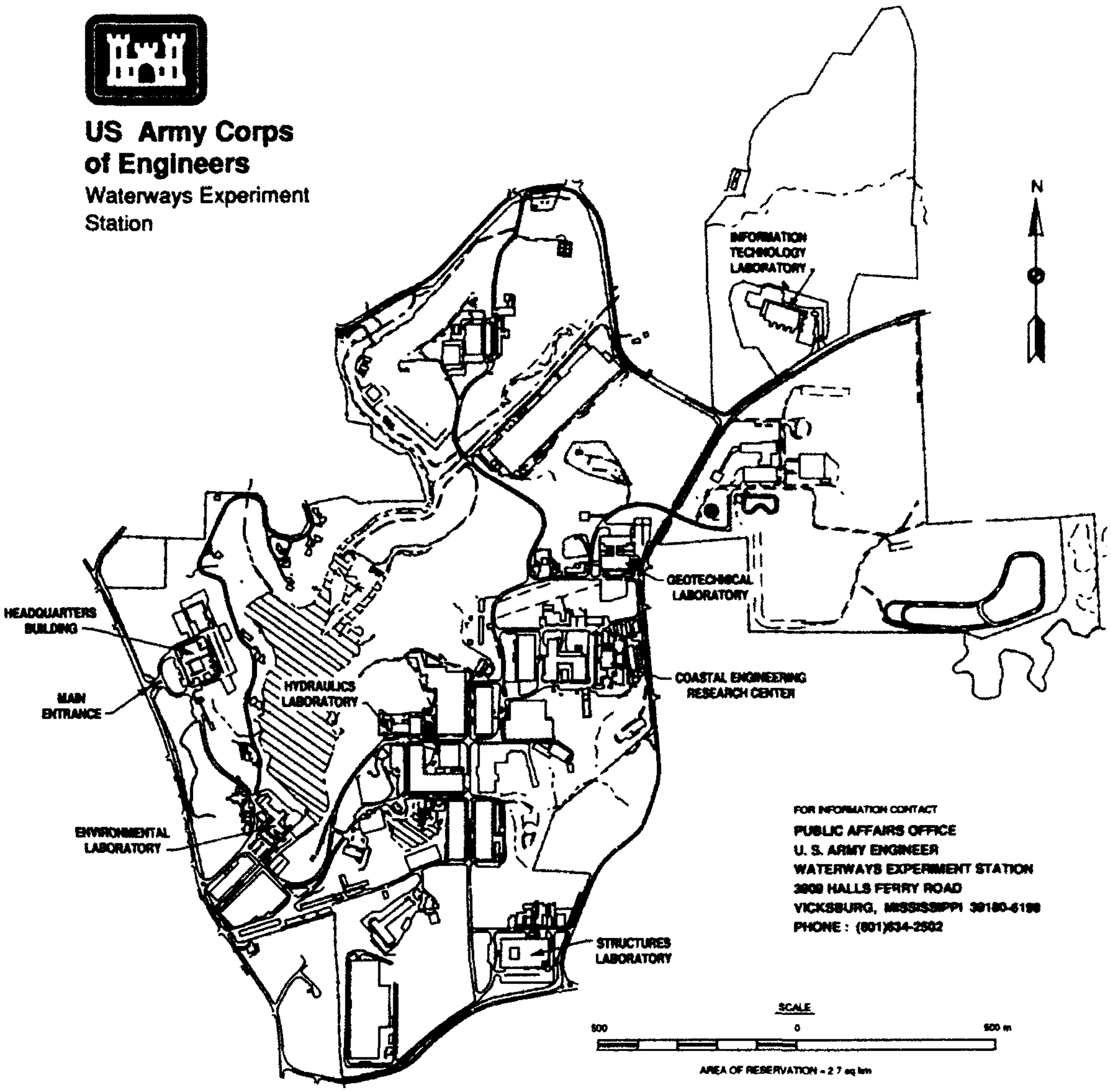

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PREFACE

The work reported herein was conducted as part of the Water Operations Technical Support (WOTS) program. The WOTS is sponsored by the Headquarters, US Army Corps of Engineers (HQUSACE), and is assigned to the US Army Engineer Waterways Experiment Station (WES) under the purview of the Environmental Laboratory (EL). Funding was provided under Department of the Army Appropriation 96X3123, Operations and Maintenance. The WOTS is managed under the Environmental Resources Research and Assistance Programs (ERRAP), Mr. J. L. Decell, Manager. Dr. A. J. Anderson was Assistant Manager, ERRAP, for the WOTS. Technical Monitors during this study were Messrs. F. B. "Pete" Juhle and Jim Gottesman, HQUSACE.

This user's guide was prepared as a technology transfer activity. This is Report 1 of a series. Report 2 is a programmer's guide. This guide was compiled from information contained in technical reports and papers previously developed at WES. The information was organized, prepared, and edited by Dr. Darrell G. Fontane, Department of Civil Engineering, Colorado State University, Fort Collins, CO, under the Inter-Governmental Personnel Agreement, and Messrs. Stacy E. Howington, Michael L. Schneider, and Steven C. Wilhelms of the Reservoir Water Quality Branch (RWQB), Hydraulic Structures Division (HSD), Hydraulics Laboratory (HL), WES. Dr. Jeffery P. Holland, Director, Computational Hydraulics Institute, HL, contributed significantly to the overall organization of the user's manual. This report is based to a large extent upon the draft of an earlier user's manual developed by Dr. Bruce Loftis, formerly of the RWQB. The report was prepared under the general supervision of Messrs. F. A. Herrmann, Jr., Director, HL; R. A. Sager, Assistant Director, HL; and G. A. Pickering, Chief, HSD.

At the time of publication of this report, Director of WES was Dr. Robert W. Whalin. Commander was COL Bruce K. Howard, EN.

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CONTENTS

CONVERSION FACTORS, NON-SI TO SI (METRIC) UNITS OF MEASUREMENT

Non-SI units of measurement used in this report can be converted to SI (metric) units as follows:

Multiply	By	To Obtain
acre-feet	1,233.489	cubic metres
British thermal units	1,055.056	joules
cubic feet	0.02831685	cubic metres
Fahrenheit degrees	5/9	Celsius degrees or Kelvins*
feet	0.3048	metres
miles (US statute)	1.609344	kilometres
square feet	0.09290304	square metres

* To obtain Celsius (C) temperature readings from Fahrenheit (F) readings, use the following formula: $C = (5/9)(F - 32)$. To obtain Kelvin (K) readings, use: $K = (5/9)(F - 32) + 273.15$.

WESTEX: A NUMERICAL, ONE-DIMENSIONAL RESERVOIR THERMAL MODEL

USER'S MANUAL

PART I: INTRODUCTION

Background

1. When a river is impounded, creating a reservoir, the physical and chemical characteristics of the river water are altered. Generally, water temperatures in the reservoir and in the releases will be cooler in the spring and warmer in the fall, because the reservoir is slower to warm and slower to cool than the river. The effects on temperature also impact other water quality constituents. The use of a reservoir outlet works incorporating selective withdrawal structures is a primary method for the control of reservoir release quality. These structures release water from specified strata in a density-stratified reservoir, thereby allowing, through blending of flows or direct release, some control of water quality.

2. Research at the US Army Engineer Waterways Experiment Station (WES) has provided technologies to assist reservoir operators and designers to address water quality considerations. Through laboratory experimentation, Bohan and Grace (1969, 1973), Grace (1971), and Bohan and Gloriod (1972) described the withdrawal zone formed by releases from a density-stratified reservoir through ports (orifice flow) and over weirs (spillway flow). An outgrowth of this initial research was the development of the one-dimensional numerical model SELECT, which computes the withdrawal zone formed by a given release through or over a specified outlet structure for a known reservoir density stratification. Research continues on refining the description of the operation of selective withdrawal structures. The most current version of the SELECT model is fully documented in a user manual by Davis et al. (1987).

3. The SELECT model is a static model in time. It requires as input a description of the thermal or density stratification of the reservoir. The model computes the release quality from the reservoir for a particular outlet structure operation; however, it does not compute the impact of the release on the reservoir's thermal or density stratification. To evaluate the ability of

a selective withdrawal structure to meet release quality objectives over a specified time frame, a dynamic model is required.

4. The WESTEX model is a dynamic, one-dimensional, numerical energy and mass budget model that predicts the thermal and density stratification patterns in a reservoir. It predicts the distribution of conservative water quality parameters, the release temperature and quality from a selective withdrawal structure, and the impact of the reservoir operation on selected water quality parameters, both within and downstream of the reservoir, on a daily basis. Since the WESTEX model is one-dimensional, it essentially predicts the vertical density and quality stratification immediately upstream of the outlet structure. The WESTEX model does not compute the required quantity of the release, only the most appropriate way to selectively withdraw the release to satisfy water quality considerations. It is assumed that the quantity of release can be predetermined by considerations other than water quality.

5. It is important for the user to realize that WESTEX was developed to evaluate the feasibility of operating a reservoir withdrawal structure in such a manner that downstream release and in-reservoir water quality objectives are satisfied. It has been applied primarily to evaluate whether proposed reservoir projects could be reasonably operated to meet water quality considerations. The model is also useful as a tool for operational planning. Based upon the results of the WESTEX model, general operational guidelines for selective withdrawal structures can be developed. These guidelines would typically suggest a strategy of port operations as a function of the time of year.

6. Although WESTEX is primarily an operations model, it can be used in an iterative manner to design the number and location of ports for a selective withdrawal outlet tower. An initial design of the withdrawal structure can be assumed and the WESTEX model run to predict the ability of the structure design to meet water quality objectives. Based upon the WESTEX results, the structure designs can be modified; that is, additional ports might be added or the existing ports relocated and the process repeated until an acceptable design that achieves water quality objectives is found.

7. The WESTEX model was initially developed by Fontane, Bohan, and Grace (1973). They modified a reservoir heat budget model developed by Clay and Fruh (1970), at the University of Texas, to fully incorporate the withdrawal zone calculations in the SELECT model. The modified model, named WESTEX (WES modification of the TEXAS model), was first applied to simulate

the thermal and turbidity structure of a proposed reservoir to assess whether the selective withdrawal outlet structure could be operated to meet release quality objectives.

8. The WESTEX model continued to be upgraded by incorporating improved descriptions of the inflow, heat exchange, and outflow processes based upon the work of Edinger and Geyer (1965), Dake and Harleman (1966), and Bohan and Grace (1973). Fontane and Bohan (1974) modified the model to consider dissolved oxygen as a quasi-conservative parameter based upon the work of Bella (1970), and applied it to simulate the thermal and dissolved oxygen structure of a proposed reservoir with pumpback characteristics. The impact of pumpback hydrodynamics on the density stratification was assessed with physical model studies, and simplified numerical descriptions were developed. Loftis* completely recoded the WESTEX model to structure the computer code into a modular format to facilitate future modifications of the model. He also significantly improved the model's input and output capabilities. Further studies of proposed pumped-storage projects by Dortch et al. (1976) and Fontane et al. (1977) provided an improved numerical description of pumpback characteristics. Improvements to the SELECT model by various researchers such as Dortch and Holland (1984) and Smith et al. (1987) have similarly been incorporated into the WESTEX model.

Purpose and Scope

9. The purpose of this report is to document Version 3.0 of the WESTEX program for field office use. This report contains descriptions of the thermal stratification processes (Part II), the computational methodologies and the sequence of operations in WESTEX (Parts III and IV, respectively), and the description of the required input data and format (Part V). The report also provides a bibliography on applications of the WESTEX model (Appendix A), examples of input files (Appendices B, C and D), example output (Appendices E, F, and G), and program error codes (Appendix H). Fontane et al. (1993) gives a listing of the program code and definitions of program variables.

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* B. Loftis. 1976. "Draft User Manual for WESTEX," US Army Engineer Waterways Experiment Station, Vicksburg, MS.

10. An attempt has been made to provide in the appendices as much useful information as possible to potential users of the model. The model has been coded in a modular form so that when modifications are required to describe essential characteristics of a particular project, these modifications can be effected as easily as possible. Inquiries concerning this model may be directed to Michael L. Schneider, Reservoir Water Quality Branch, Hydraulics Laboratory, WES, at (601) 634-3424.

PART II: THERMAL CHARACTERISTICS OF RESERVOIRS

Density Stratification

11. The phenomenon known as density stratification is of fundamental importance in understanding the physical, chemical, and biological characteristics of impoundments and the change of those characteristics with time. Density stratification is often described in terms of thermal stratification since temperature is the primary factor affecting water density. Thermal stratification is the term applied to the division of a lake into layers that exhibit differences in temperature and consequently differences in density.

12. The principal factors that influence the development of thermal stratification include the effect of temperature on water density, the low thermal conductivity of water, the limited penetration of heat transferred through the air-water interface, and the seasonal variation of stream temperatures and meteorological conditions. Figure 1 is a plot of water temperature versus density of water. The standard relationship between temperature of water and the corresponding density is given by:

$$\rho(\theta) = 1 - (\theta - \alpha_1)^2 / \alpha_2 (\theta + \alpha_3) / (\theta + \alpha_4) \tag{1}$$

where

ρ = density of water, g/ml*

θ = temperature of water, °C

α_1 = 3.9863

α_2 = 508929.2

α_3 = 288.994

α_4 = 68.129

13. It is apparent from Figure 1 and Equation 1 that when water temperatures are near 4 °C, incremental temperature changes have a minimal effect on density, and the effect increases on either side of 4 °C. At higher temperatures, incremental temperature changes result in large changes in density.

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* For convenience, symbols and unusual abbreviations are listed and defined in the Notation (Appendix I).

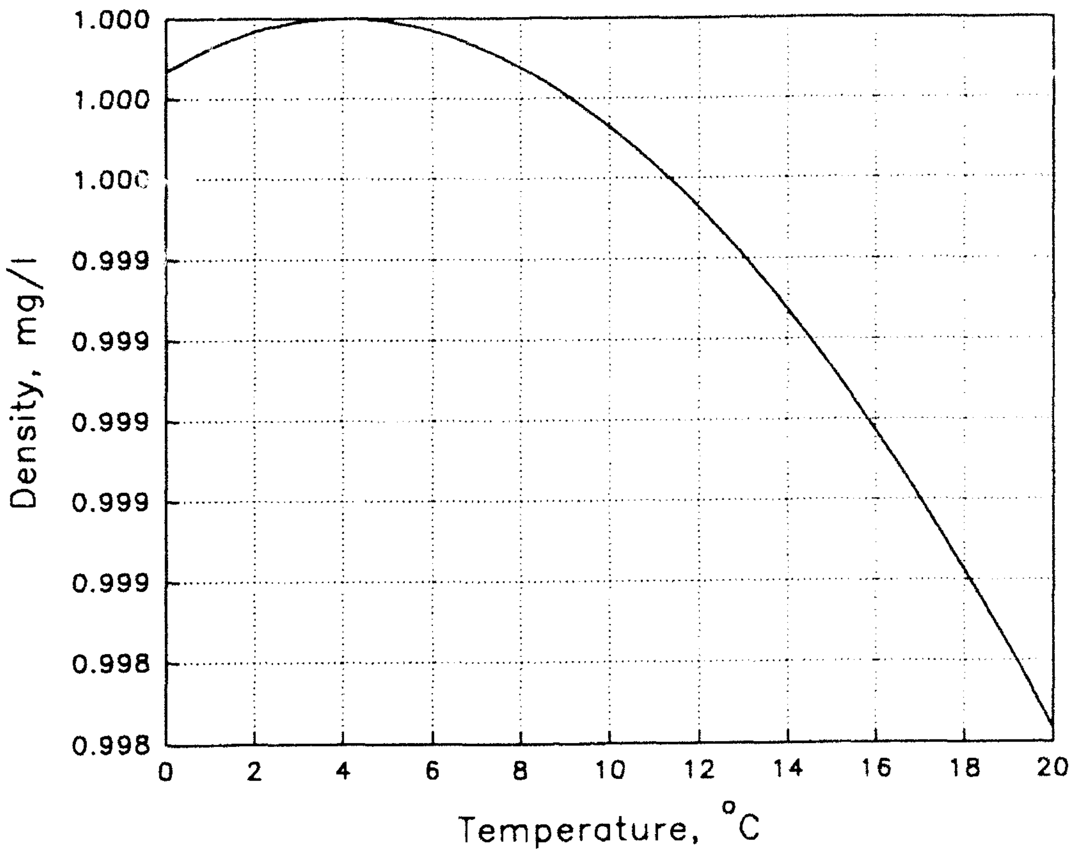

Figure 1. Water density as a function of water temperature

The implication of this is twofold. First, a minimum amount of external energy is required to overcome gravitational forces and mix a body of water with small temperature differences when the average water temperature is close to 4 °C. A much larger amount of energy is required for mixing small temperature differences when the average water temperature is warmer than 4 °C. Second, a minimum of energy is required to mix a body of water that is essentially uniform in temperature as compared to a body of water in which layers of water at various temperatures exist.

14. Other factors such as dissolved substances can also affect the density of water. The expression used to evaluate density as a function of temperature and the concentrations C of any number of water quality constituents is as follows:

$$\rho(\theta,C) = \rho(\theta) + \sum_{j=1}^{N} C_j\left(1 - \frac{1}{S_j}\right)10^{-6} \qquad (2)$$

where

j = index for water quality constituent

N = number of water quality constituents excluding temperature

C_j = concentration of water quality constituent, mg/l

S_j = specific weight of constituent

15. Thermal stratification in lakes is dependent on many factors, the most important of which are geographic location, elevation, climatologic and hydrologic conditions, depth, storage volume, surface area, discharge capabilities, and other physical characteristics of the lakes. In the late winter and early spring, a lake will often exhibit an isothermal condition. This condition is characterized by uniformity of temperature and water quality parameters throughout the depth of the pool and low resistance to internal mixing. As the season advances, the upper layers of the lake begin to warm due to the heat transfer that occurs across the air-water interface and the advection of warmer inflows. During the spring, the rate at which the incoming thermal energy can be distributed downward is exceeded by the rate of incoming heat; the amount of energy required to mix the lake increases rapidly; and the characteristic temperature gradient develops in the upper layers. As the intensity of solar radiation increases, more energy penetrates into the upper layers, and the lake begins to stratify. The temperature of the lower layers remains virtually unchanged. The temperature gradient and corresponding density gradient increase the resistance of the lake to internal mixing.

16. The impoundment will eventually resemble a three-level body of water with the lighter warmer water, the epilimnion, on top separated from the cooler denser bottom water, the hypolimnion, by a transition region, the metalimnion, as illustrated in Figure 2. The metalimnion can be identified as the region between the two planes of maximum curvature of the temperature profile. The thermocline is defined as the plane of maximum rate of decrease of temperature with depth. The strong density gradient allows the metalimnion to act as a barrier between the epilimnion and the hypolimnion. In the epilimnion, wind-induced mixing at the surface distributes energy downward into the pool and is limited by the increased density gradient in the metalimnion. The difference between the densities of epilimnetic water and hypolimnetic water is thus increased. During the summer, the resistance to internal mixing is so great in most lakes that they are said to be stably stratified.

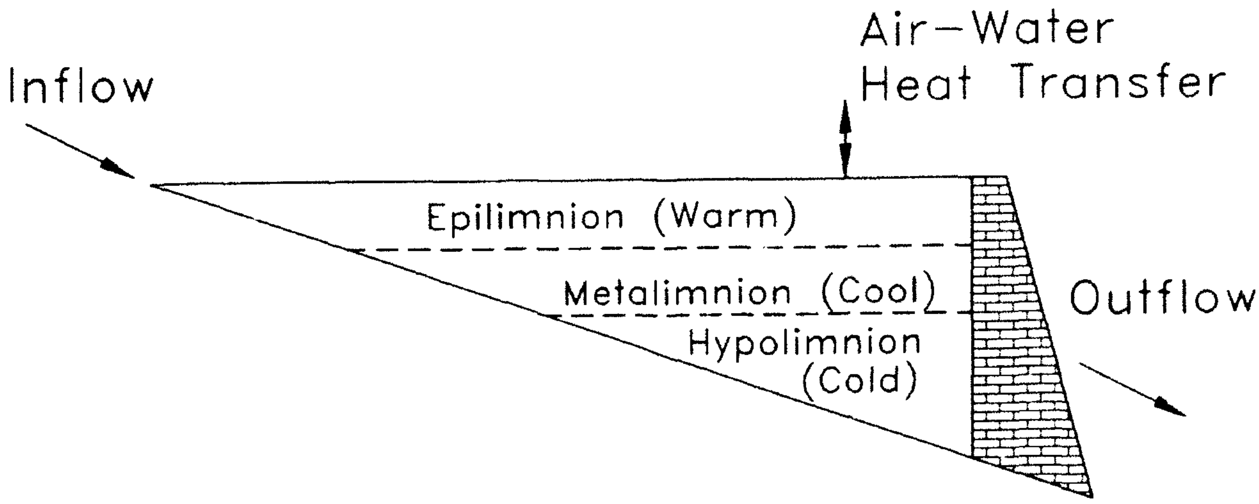

Figure 2. Three-zone temperature stratification

17. In midsummer, the surface temperatures are further increased due to energy input at the air-water interface. The metalimnion is well established and quite stable. In deep lakes the hypolimnetic temperatures exhibit little increase after stratification is established. In shallow lakes, hypolimnetic temperatures may increase as much as 15 °C above early spring conditions. Thermal stratification persists in the impoundment until late summer or early fall, when the influent water becomes cooler and the net energy addition at the surface begins to decrease and eventually becomes negative. The surface water becomes cooler and mixing occurs throughout the epilimnion and into the metalimnion by wind action and convection. As the metalimnion is eroded, cooling at the surface accelerates and convective mixing rapidly deepens the surface isothermal zone. Cooling continues until the temperatures and densities of the epilimnion and metalimnion approach those of the hypolimnion. As this occurs, resistance to mixing is steadily decreased until the lake is thoroughly mixed and the fall overturn has occurred.

18. In some northern lakes, a winter stratification may also develop. As cooling continues through fall and winter, water at the surface will become colder than 4 °C, and thereby less dense, and a reverse of the summer stratification will develop. This condition may remain until late winter when the impoundment begins to warm. The summer stratification pattern will then repeat itself for the next year.

19. The preceding discussion is for the most traditional case of thermal stratification. While many Corps of Engineers reservoirs exhibit this traditional stratification pattern, some reservoirs may exhibit differing

stratification patterns as a function of these reservoirs' characteristics including depth and ratio of volume to inflow. For example in main stem hydropower projects, the hypolimnion of the reservoir may be replaced entirely by inflows one or more times during a stratification season.

External Heat Sources and Sinks

20. To evaluate the thermal structure of a reservoir, the external heat sources and sinks must be described. The most important processes by which heat may be gained or lost in an impoundment are advection, heat transfer at the solid boundaries, and heat transfer at the air-water interface.

21. The quantity of heat added by inflows can be computed from the inflow quantity and the inflow temperature. The quantity of heat extracted from a lake can be approximated with selective withdrawal techniques. The net heat gained by a lake due to advection can be computed by the following equation:

$$H_{n,a} = q_i C_p \rho \theta_i - q_o C_p \rho \theta_o \tag{3}$$

where

$H_{n,a}$ = net rate of advected heat, Btu/day

q_i = rate of inflow, ft^3/day

C_p = specific heat of water at constant pressure, Btu/lb/day

ρ = density of water, lb/ft^3

θ_i = inflow water temperature, °F

q_o = rate of outflow, ft^3/day

θ_o = outflow water temperature, °F

22. If significant groundwater inflows are present, then an additional term accounting for this heat source must be added to Equation 3 and the additional volume of water included within the inflow process.

23. The evaluation of heat transfer at the solid boundaries (i.e., the ground surface and face of the dam) is difficult due to a lack of prototype data, but it is usually small and is almost always neglected. However, the process may be described by:

$$H_g = K_g(\theta_h - \theta_g)/h \tag{4}$$

where

H_g = rate of heat transfer through the ground, Btu/ft^2/day

K_g = thermal conductivity of the bottom mud, Btu/ft/day/°F

θ_h = temperature of mud at h ft below mud-water interface, °F

θ_g = water temperature at the mud-water interface, °F

h = distance below mud-water interface, ft

24. As described by Edinger and Geyer (1965), the net rate of heat transfer between the atmosphere and the surface of the lake is composed of seven heat exchange mechanisms operating at the air-water interface and may be expressed as:

$$H_n = H_s - H_{sr} + H_a - H_{ar} \; (+/-) \; H_c - H_{br} - H_e \tag{5}$$

where

H_n = net heat transfer at the air-water interface, Btu/ft^2/day

H_s = short-wave solar radiation arriving at the water surface, Btu/ft^2/day

H_{sr} = reflected short-wave radiation, Btu/ft^2/day

H_a = long-wave radiation, Btu/ft^2/day

H_{ar} = reflected long-wave radiation, Btu/ft^2/day

H_c = heat transfer by conduction, Btu/ft^2/day

H_{br} = back radiation water surface, Btu/ft^2/day

H_e = heat loss by evaporation, Btu/ft^2/day

25. The relative variation between the average daily values of each of these terms is indicated in Table 1.

26. Using procedures presented by Edinger and Geyer (1965), the seven heat exchange mechanisms can be evaluated and the net interfacial heat transfer can be expressed as a function of water temperature, meteorological conditions, and some descriptive parameters. The resulting expression can be reduced to:

$$H_n = K(E - \theta_s) \tag{6}$$

Table 1

Variation of Heat Exchange Terms

Term	Range, Btu/ft²/day*
H_s	400 - 2,800
H_a	2,400 - 3,200
H_{sr}	40 - 200
H_{ar}	70 - 120
H_{br}	2,400 - 3,600
H_c	320 - 400
H_e	2,800 - 8,000

where

K = surface heat exchange coefficient, Btu/ft^2/day/°F

E = equilibrium temperature, °F

θ_s = water surface temperature, °F

27. The equilibrium temperature is defined as the water surface temperature for which there is no net heat transfer across the air-water interface. Thus, for a specified set of meteorological data, a body of water that has a surface temperature less than the equilibrium temperature will approach the equilibrium temperature by warming, that is, by heat transfer from the atmosphere. Similarly, a body of water with surface temperature greater than equilibrium will approach the equilibrium temperature by cooling, or by heat transfer to the environment. The equilibrium temperature is computed as a function of meteorological conditions, specifically dry bulb temperature, dew-point temperature, cloud cover, and wind speed. Significantly, it is not a function of water surface temperature. The coefficient of surface heat exchange is the net rate at which heat is lost or gained by a body of water per unit difference of equilibrium temperature and water surface temperature. This coefficient also is not dependent upon water surface temperature and is in fact solely a function of wind speed.

28. It is possible to formulate a general expression for the overall heat balance of a lake for a specified time period. The expression for this balance is as follows:

* A table of factors for converting non-SI units of measurement to SI (metric) units is found on page 3.

$$\Delta\theta = \frac{1}{\rho C_p V} (H_i - H_o + A_s H_n + A_g H_g) \Delta t \qquad (7)$$

where

$\Delta\theta$ = average temperature change during time interval, °F

ρ = density of water, lb/ft^3

C_p = specific heat of water, Btu/lb/°F

V = volume of lake, ft^3

H_i = heat added by inflow, Btu/day

H_o = heat extracted by outflow, Btu/day

A_s = surface area of lake, ft^2

H_n = net heat added at the air-water interface, $Btu/ft^2/day$

A_g = area of mud-water interface, ft^2

H_g = net heat added at the mud-water interface, $Btu/ft^2/day$

Δt = time increment, days

29. The solution of this equation over sequential time intervals will yield the variation over time of temperature or total heat content within a completely mixed, isothermal lake. However, because of the stratification phenomenon, an analysis of the internal distribution of heat is required.

Internal Heat Distribution

30. Heat transfer through the air-water interface is the primary factor responsible for the thermal stratification pattern exhibited by most lakes. However, the actual shape of the thermal profile and the development of the stratification is dependent upon several distinct processes, the most significant of which are the following:

a. Inflow.

b. Outflow.

c. Internal mixing.

d. Wind mixing.

e. Penetration of solar radiation.

f. Convective mixing.

31. It is instructive to consider each of these mechanisms and the effect each has independently on an existing temperature stratification. With

the one-dimensional assumptions, longitudinal and lateral thermal gradients are assumed to be negligible, and a single vertical profile can be considered representative of the entire lake. As the inflow process occurs, the water surface elevation rises. Assuming that the temperature of the inflowing water is cooler than the surface waters of the lake, the inflowing water plunges as it enters the lake. Water is entrained from the surface, and entrainment continues as the inflow current flows along the bottom. The inflow current separates from the bottom and flows horizontally into the pool at the depth at which the density of the lake is equal to the density of the inflow current. The water above the inflow density level is pushed upward. There is an overall cooling of the impoundment above the inflow density level due to the energy redistribution.

32. When a withdrawal is made from the reservoir, a void is created throughout the zone of withdrawal. An energy redistribution is made based upon the volumetric characteristics of the lake. The warm water shifts downward to fill the void created by withdrawal, with the areas in and above the withdrawal zone exhibiting a warmer profile after withdrawal. The shape of the profile is somewhat distorted as the strata are redistributed into the lower depths of the lake. The water surface falls as a result of the withdrawal process.

33. The effect of internal mixing is to redistribute thermal energy vertically. Energy is redistributed only slightly in the region of steepest density gradient, but the mixing process results in a smoother temperature profile. For wind-induced mixing in the upper layers of the lake, the temperature of the epilimnion is decreased with a resultant steepening of the thermal gradient within the epilimnion. Wind mixing is likely to be more dynamic than hypolimnial mixing, but both types of mixing are limited in extent due to the metalimnial barrier that exists in a stratified impoundment.

34. As short-wave solar radiation enters the impoundment, its passage through the water is attenuated, and most of the energy goes into the upper layers of the impoundment. An exponential decay can be used to describe this attenuation. The degree of stratification has no direct effect on the depth of penetration of the short-wave radiation, which is primarily a function of intensity and light transmissibility (water clarity).

35. The last mechanism to be considered is convective mixing near the surface. As the surface cools, especially at night, a density instability

exists because cooler, denser water is located on top of warmer, less dense water. A convective cell develops resulting in a well-mixed epilimnion.

Dynamic Thermal Balance

36. If a reservoir is conceptualized in a one-dimensional representation as a number of homogeneous horizontal layers stacked vertically, then the heat sources and sinks to a general layer can be represented as shown in Figure 3. Conservation of mass and conservation of heat for a control volume can be expressed as:

$$Q_i = Q_o \tag{8}$$

$$\Delta H = H_{in} - H_{out} \tag{9}$$

where

Q_i = flow into control volume, ft^3/day

Q_o = flow out of control volume, ft^3/day

ΔH = net heat of control volume, Btu/day

H_{in} = heat added into control volume, Btu/day

H_{out} = heat extracted from control volume, Btu/day

37. The change in temperature of a general layer over time can be represented by:

$$\frac{\partial \theta}{\partial t} = \frac{\theta_i Q_i}{A \Delta Z} - \frac{\theta_o Q_o}{A \Delta Z} + \frac{1}{A} \frac{\partial}{\partial Z} \left(kA \frac{\partial \theta}{\partial Z} \right) - \frac{1}{A} \frac{\partial (Q_v \theta)}{\partial Z} + \frac{1}{\rho C_p A} \frac{\partial H}{\partial Z} \tag{10}$$

where

θ = temperature of layer, °F

t = time, days

θ_i = inflow temperature, °F

Q_i = flow rate into layer, ft^3/day

A = horizontal cross sectional area, ft^2

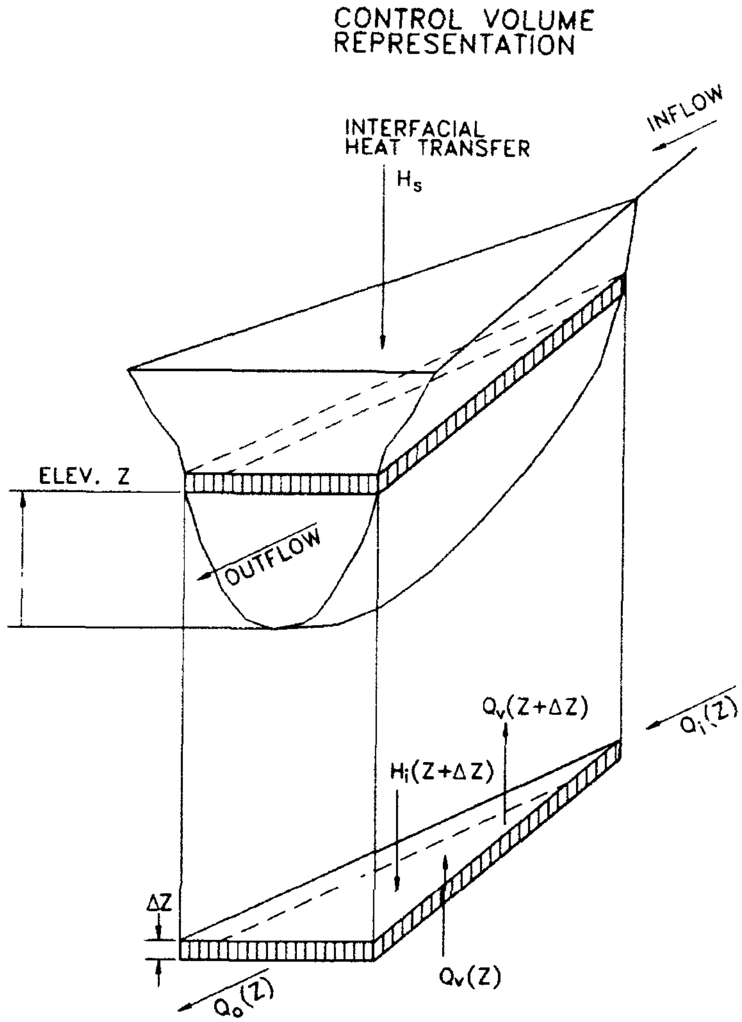

Figure 3. Typical layer in one-dimensional description

ΔZ = layer thickness, ft

θ_o = outflow temperature

Z = elevation, ft

k = vertical diffusion coefficient, ft^2/day

Q_v = net vertical flow out of layer, ft^3/day

ρ = density of water, lb/ft^3

$\frac{\partial H}{\partial Z}$ = external heat source, Btu/ft/day

38. Appropriate boundary conditions must be supplied at the air-water interface and the mud-water interface. Solution of this equation for each layer through time will yield the dynamic vertical temperature distribution within a lake.

39. Conservative water quality constituents are those parameters for which the concentration in an elemental volume is affected only by dilution, not by biological processes, chemical reactions, or physical phenomena such as gravity. Clay and Fruh (1970) indicated that suitable conservative constituents for simulation might include chloride, sulfate, sodium, or silica concentrations. Conservative constituent concentrations can be budgeted in a manner similar to that used for the heat budget. Using conservation of mass, the change over time of conservative constituent concentrations within a layer can be represented by:

$$\frac{\partial C}{\partial t} = \frac{C_i Q_i}{A \Delta Z} - \frac{C_o Q_o}{A \Delta Z} - \frac{1}{A} \frac{\partial (Q_v C)}{\partial Z} + \frac{1}{A} \frac{\partial}{\partial Z} \left(\frac{k A \partial C}{\partial Z} \right) \tag{11}$$

where

C = concentration of conservative constituent, mg/l

C_i = inflow concentration, mg/l

C_o = outflow concentration, mg/l

Q_o = outflow rate, ft^3/day

40. It is significant to note that parameters such as dissolved salts change the density of water as a function of concentration and specific gravity. Suspended materials such as that within turbidity currents will likewise impact the water density (Ford and Johnson 1983).

41. Bella (1970), Fruh and Davis (1972), and Markofsky and Harleman (1971) have demonstrated the application of a one-dimensional model to describe a nonconservative constituent budget. Nonconservative parameters are budgeted similar to conservative parameters except the nonconservative processes must also be considered. Bella's (1970) development of a one-dimensional model for dissolved oxygen structure of a lake yielded a governing equation similar to Equation 11, with an additional term representing the result of photosynthetic and respiration processes. Fruh and Davis (1972) and Markofsky and Harleman (1971), likewise, used one-dimensional models to describe vertical dissolved oxygen structures in a lake. Fontane, Bohan, and Grace (1973) simulated turbidity currents by representing the settling characteristics of the suspended material.

PART III: WESTEX MODEL DESCRIPTION

Introduction

42. The WESTEX model provides a procedure for examining the balance of thermal energy imposed on an impoundment. This energy balance and lake hydrodynamic phenomena are used to dynamically simulate vertical temperature profiles and release temperatures. The model includes computational methods for simulating heat transfer at the air-water interface, advective heat transfer of inflow and outflow, and the internal dispersion of thermal energy. Additionally, there is a heuristic search procedure for determining which ports should be open and to what extent the ports should be open in order to minimize deviation of the predicted release temperature from a specified downstream target temperature. The model is conceptually one-dimensional based upon the division of the impoundment into discrete horizontal layers of uniform thickness (but nonuniform volume) as illustrated in Figure 3. Fundamental assumptions include the following:

a. Isotherms are parallel to the water surface both laterally and longitudinally.

b. The water in each discrete layer is isotropic and physically homogeneous.

c. Internal advection and heat transfer occur only in the vertical direction.

d. External advection (inflow and outflow) occurs as a uniform distribution within each layer.

e. Internal dispersion of thermal energy is accomplished by a lumped diffusion mechanism that combines the effects of molecular diffusion, turbulent diffusion, and thermal convection.

f. There is no heat exchange through the mud-water interface.

43. The surface heat exchange, internal mixing, and advection processes are simulated separately, and their effects are introduced sequentially. A simplified flowchart of the simulation procedure is illustrated in Figure 4. This sequential solution procedure has proven to be a valuable alternative to the simultaneous solution of the one-dimensional heat equation, Equation 10, written for each of the layers. While solving each term sequentially instead of simultaneously is not particularly mathematically appealing since the processes occur simultaneously in nature, it provides a great deal of flexibility in analysis of projects with special characteristics. One notable example was

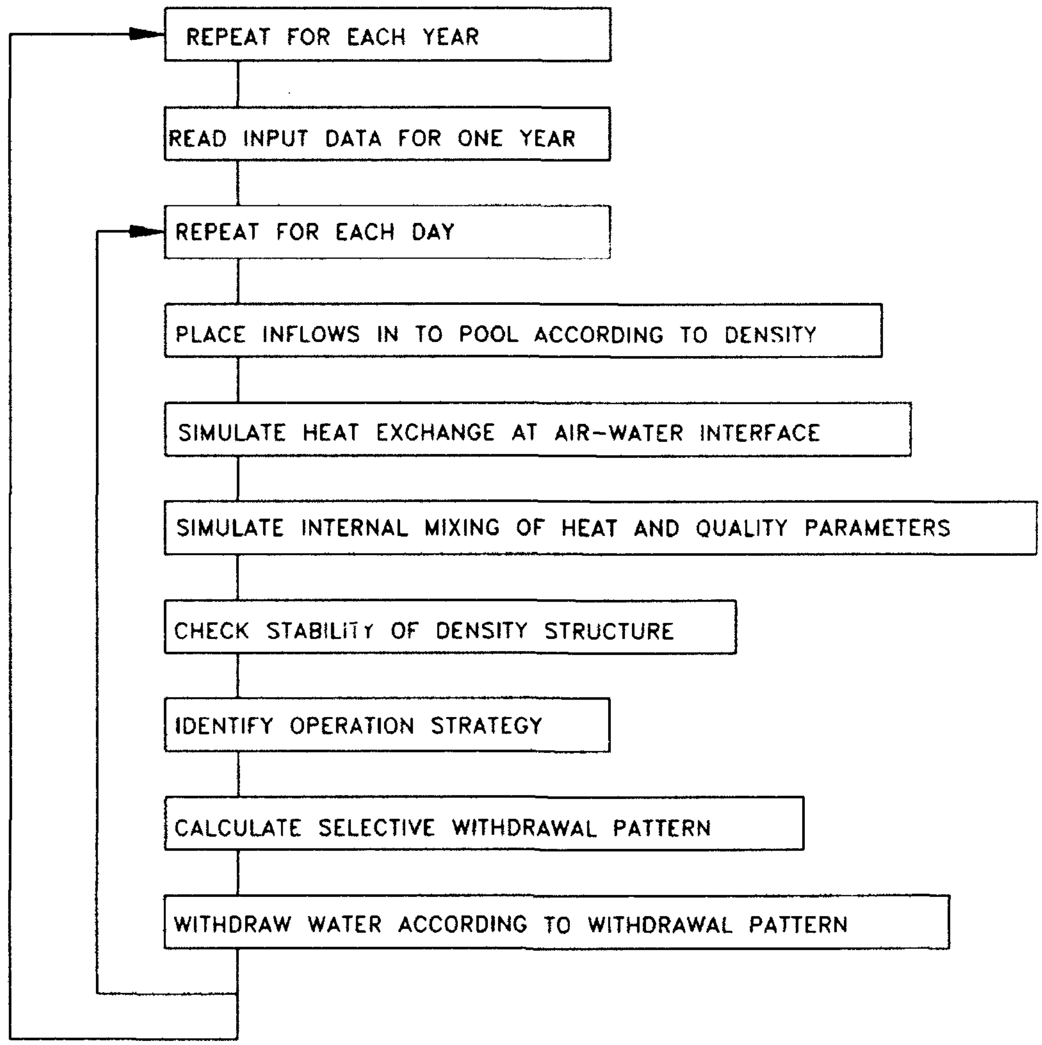

Figure 4. Simplified WESTEX flowchart

the use of a modified version of WESTEX to simulate the operation of Dickey and Lincoln-School Lakes, a pumped-storage system in northern Maine (Dortch et al. 1976). One unique feature of this project is the possibility of several cycles of downstream generation and subsequent pumpback into the upper lake during the course of a single day. Because of numerous regulation cycles and the fact that evaluation of the heat budget requires knowledge of the flow rates while evaluation of the water budget requires knowledge only of the flow volume, it was convenient to simulate the system by applying the inflow, heat exchange, and mixing processes on a daily time increment and applying each generation or pumpback process for only a specified duration. Thus, the sequential solution procedure was essential for simulating processes with different time-steps. With a model in modular form as the WESTEX model, one

module or subprogram can be modified to describe particular characteristics with a minimum of interaction with other modules.

44. WESTEX is primarily a heat budget model. That is, temperature is the fundamental water quality parameter under consideration. However, the model is capable of performing a simple routing of conservative water quality constituents. The actual budgeting of conservative constituent concentrations is performed identical to the budgeting of heat. In fact, every section of code that performs a heat budget, with the exception of the surface heat exchange mechanism, is followed by a similar section of code that performs a concentration budget for quality parameters. If it is concluded by the user that nonconservative constituents can be adequately simulated with WESTEX, then it is apparent that the nonconservative aspects will have to be handled in some manner that is distinct from the heat budgeting mechanisms. For the purposes of model description, the heat budget will be described in detail and the budgeting of concentrations of conservative constituents will not be described since the budgeting procedure is identical to the heat budgeting procedure. The two exceptions are the lack of a conservative constituent analogy for surface heat exchange and the use of Equation 2 to determine density when other water quality parameters are present.

Components of the Model

45. The process of inflow into a reservoir is simulated numerically in WESTEX in four steps: the inflow current entrains water from the surface layer as it enters the reservoir, the point of neutral buoyancy of the inflow current including the entrained water is determined, water in the reservoir is displaced by and mixed with the inflow, and a new water surface elevation is computed.

46. Prototype observations and physical model studies at WES have demonstrated the existence of entrainment-induced density currents that flow upstream along the surface into the turbulent mixing zone caused by inflow. Entrainment is implemented in the model by augmenting the inflow quantity with a volume from the surface layer. Characteristics of the inflow volume and the entrained volume are volume weighted and averaged, and mixed values of density, temperature, and other water quality parameters, if modeled, are determined. The mixed inflow density is used to determine vertical placement

of the total inflow volume at the point of neutral buoyancy.

47. The point of neutral buoyancy is found by a linear interpolation or extrapolation of the density profile of the lake. The inflow volume is allocated to the layer of neutral buoyancy. The contents of the layer of neutral buoyancy are then fully mixed with the inflow quantity, thereby producing a volume-weighted average temperature for this layer. The inflow volume into the neutrally buoyant layer causes the physical capacity of that layer to be exceeded (unless the neutrally buoyant layer is a partially full surface layer), and the excess is displaced upward at the mixed temperature of the inflow layer. This displacement either flows into the next higher layer or forms a new surface layer. If the layer of neutral buoyancy is below the surface layer, the excess volume is fully mixed with the layer above and a new volume-weighted temperature for that layer is produced. The process continues in this sequential fashion until the introduction of the excess volume from one layer into the next highest layer does not exceed the physical capacity of the upper layer.

48. If the inflow current is found to be an overflow (the inflow density is less than that of the surface layer), the inflow quantity is mixed with the volume of the surface layer. If the inflow quantity exceeds the volume of the surface layer, the excess forms a new surface layer at the mixed temperature of the inflow layer. The addition of the inflow quantity in any manner results in an increase in the surface elevation.

Surface Heat Exchange

49. The WESTEX model employs an approach to the evaluation of surface heat exchange developed by Edinger and Geyer (1965). For every day of meteorological data, the procedure formulates equilibrium temperatures and coefficients of surface heat exchange as described in Equation 6 based upon the sum of seven heat exchange processes described in Equation 5. The computation of equilibrium temperature and coefficient of surface heat exchange is based solely upon meteorological data as outlined by Edinger, Duttweiler, and Geyer (1968). A computer program and user's manual to compute these data (Eiker 1972) can be obtained from the WES Engineering Computer Programs Library.

50. The surface heat exchange processes, with the exception of shortwave radiation, affect only approximately the top few feet of the lake.

Short-wave radiation penetrates the water surface and increases the temperature at greater depths. Based upon laboratory investigations, Dake and Harleman (1966) suggested an exponential decay with depth for describing the heat flux due to short-wave penetration.

51. The surface heat exchange concepts are implemented in WESTEX by the exponential penetration of a percentage of the incoming short-wave radiation and the placement of the effect of all other sources of surface heat exchange into the top 2 ft of the lake. This procedure can be expressed mathematically by the following two equations:

$$H_{s\ell} = K(E - \theta_s) - (1 - \beta)\psi \tag{12}$$

$$H_{Z_i} = (1 - \beta)\psi\, e^{-\eta Z_i} \tag{13}$$

where

$H_{s\ell}$ = heat transfer flux into the surface layer, Btu/ft^2/day

β = short-wave radiation absorbed into upper 2 ft, percent

ψ = total incoming short-wave radiation flux, Btu/ft^2/day

H_{Z_i} = heat transfer flux passing through plane at depth Z_i , Btu/ft^2

e = natural logarithmic base (2.7183)

η = heat absorption coefficient, ft^{-1}

Z_i = depth below surface at midpoint of layer i, ft

52. The use of a 2-ft thickness, within which the effects of surface heat exchange processes are applied, has consistently produced acceptable results in previous studies. This value is set with a DATA statement in the model in the heat exchange subprogram and can, therefore, be changed easily. However, changing the 2-ft thickness value is not recommended unless there is specific justification for altering this value.

53. If consideration is given to the temperature profile in a column of water with cross-sectional area of 1 ft^2 and heat transfer taking place over 1 day, then the heat flux terms can be represented by heat quantities. By the one-dimensionalization of a lake, it is assumed that this temperature profile exists throughout the lake, and thus, it is possible to compute temperature

changes from known values of the heat flux terms.

54. Since pool elevation changes daily, the thickness of the surface layer will vary from nearly zero to the full thickness of a general layer. Thus, the 2-ft heat exchange depth could be contained completely in the surface layer, or the surface layer and one or two lower layers could be required, depending upon layer thickness and surface thickness. If the surface heat exchange depth is contained entirely in the surface layer, an additional component of heat in the surface layer due to the exponential short-wave penetration must be considered. This extra component of heat is computed with Equation 13 as the difference in quantity of heat passing through the bottom of the 2-ft depth and the quantity passing through the bottom of the surface layer. Thus, it is possible to compute the heat addition due to the surface processes in all of the layers into which the 2-ft depth extends.

55. The net quantity of heat distributed into the lower layers (those layers that contain no part of the top 2-ft depth) is the term $(1 - \beta)\psi$ minus the additional short-wave component in the lowest layer into which the 2-ft depth extends. It is possible to determine the heat entering each of the lower layers by computing the difference in the heat quantity passing through the top of the layer and the heat quantity passing through the bottom of the layer. The WESTEX model instead evaluates the term $e^{-\eta z}$ for the midpoint of each lower layer, providing the shape of the short-wave distribution curve for the lower layers. This heat curve is then scaled such that the sum of the quantities of heat entering the lower layers is equal to the net heat distributed into the lower layers. After the heat addition to each layer from the bottom to the surface is computed, the corresponding temperature change can be determined.

56. It should be noted from Equation 5 that the net heat exchange at the air-water interface can be positive or negative. It is usually positive in the spring when heat is transferred to the lake from the atmosphere and is usually negative in the fall when the lake loses heat to the atmosphere. However, the process is modeled by putting most of the short-wave radiation, which is always positive, into the lower layers of the pool and the balance of the heat into the top 2 ft. The heat transfer within the top 2 ft can be negative even when the net heat transfer is a relatively large positive value. Thus, the condition arises of cooling the top layer and warming the layer below the surface layer. This can result in a temperature instability.

Another subprogram in WESTEX will mix the temperatures from the top down until a stable profile is achieved. This process reproduces the well-mixed epilimnetic zone that is observed in nature.

57. The parameters β and η are input data to the model and can be adjusted to change the shape of the temperature profile. Both parameters are dependent upon the light transmissibility of the water, directly in the case of η and more indirectly for β. For very clear lakes η and β will typically be small, and for turbid lakes η and β will typically be in the upper part of the ranges. The ranges are approximately 0.4-0.9 for β and 0.1-1.0 for η. Both β and η are numerical model inputs that are generally determined by calibration or through correlation with Secchi disk measurements (Williams 1980).

Mixing

58. The internal mixing process in the WESTEX model is represented by a mixing scheme based upon an integral energy model (Ford 1976). The model assumes the lake to be composed of a well-mixed upper region (epilimnion) overlying a stable lower region (hypolimnion). The depth of this well-mixed upper region is determined by comparing the available kinetic energy influx from wind shear to the work required to lift an incremental volume (a layer) of water from the stable lower region to the center of mass of the well-mixed region. If the available kinetic energy influx is greater than the computed work required for mixing, the two volumes are mixed. The available kinetic energy influx is then reduced by the required work, plus dissipation due to viscosity and internal wave effects. The dissipation term is computed from the Richardson number formulation developed by Bloss and Harleman (1979). Conversely, if the work required to mix the volume with the well-mixed region is greater than the available kinetic energy influx, no mixing occurs and the depth of the well-mixed region is established at its present depth.

59. Mixing in the hypolimnion is approximated by an eddy diffusion approach. A diffusivity coefficient of approximately ten times the molecular diffusivity coefficient was used in this approach, which accounted for the effects of molecular diffusion, turbulent diffusion, and additional internal processes not explicitly addressed. This value has been investigated in a number of studies including Bloss and Harleman (1979).

Stability

60. Although nature can exhibit a small amount of density instability, the WESTEX model requires a stable profile prior to application of selective withdrawal techniques for outflow. Stability is assured by searching adjacent layers from bottom to top, comparing densities. If a density instability is identified, the two unstable layers are mixed. The mixed density is then compared to the density of the layer above the mixed region and the process continues until stability is achieved or the surface is reached. By mixing layers above an instability, it is possible to create an instability below the mixed region. If such an instability is detected, then mixing proceeds downward until stability is achieved.

Operation Strategy

61. The operation strategy consists of determining the total outflow to be released from the reservoir, the specific outlets to be used to release the outflow, and the flow to be released from each outlet. The WESTEX model does not contain an algorithm to calculate the amount of total release based upon meeting water quality objectives. It is assumed that the amount of total release is based upon satisfying other water quantity objectives. The total release is specified in the model either by specifying the precise release for each day of simulation or by specifying a storage-based operation guide curve. The guide curve is used to calculate the required total release for each day of simulation.

62. The WESTEX model can be run in two operation modes, a VERIFICATION mode and a PREDICTION mode, that control the operation of the selective withdrawal structure. In the VERIFICATION mode, the specific release from each outlet in the selective withdrawal structure must be designated for each day of simulation. In the PREDICTION mode, an outflow target temperature is specified for each day of simulation and a search algorithm is used to determine the specific release from each outlet in the selective withdrawal structure to attempt to achieve this target release temperature.

63. The search algorithm to determine outlet operations in the PREDICTION mode requires a description of the selective withdrawal outlet structure that includes the number of wet wells, the number and vertical

locations of the outlets in each wet well, the geometry of the individual outlets, the upper and lower flow constraints for each outlet, and the upper and lower flow constraints on the wet wells and outlet structure. The algorithm searches for the combination of the minimum number of vertically adjacent outlets that can be used to achieve the desired release target temperature. Restrictions about the use of outlets in the same wet well or other restrictions on the use of outlets based upon the hydraulic operation of the outlet works can be incorporated in this algorithm. Currently the WESTEX model uses a maximum of three open ports, one from each of two wet wells and a floodgate, to achieve the desired release target. Experience at WES has shown that this is sufficient for simulating most release conditions. Additional description of this port selection process is available in the user manual for the SELECT model by Davis et al. (1987).

Special Operations

64. As described previously, the WESTEX model has been adapted to study the operation of pumped storage hydropower systems. Details of these studies are documented by Fontane and Bohan (1974), Dortch et al. (1976), Fontane et al. (1977), and Smith et al. (1987). Physical models were used to determine the source, magnitude, and distribution of the reservoir waters entrained into the pumpback jet and to characterize the amount of mixing induced by the pumpback operations. Since the incorporation of these special operations is site specific, generalized algorithms for pumped storage operations do not exist. Users interested in these kinds of studies should contact WES.

Selective Withdrawal Pattern

65. The selective withdrawal techniques in the SELECT model (Davis et al. 1987) are contained within a subprogram of the WESTEX model to compute the limits of the zone of withdrawal from an outlet and the distribution of withdrawal velocity within that zone of withdrawal. Transcendental equations defining the location of the zero-velocity limits are solved iteratively. The zero-velocity limits are functionally dependent upon the release flow rate, the geometry of the intake (except in the case of a point sink), and the density structure of the reservoir upstream of the intake. After

determination of the withdrawal limits, the outflow withdrawal velocity profile and the flow-weighted release temperature are computed. The change in the internal heat budget is then computed to account for the vertical advection resulting from the specified outflow. If multilevel ports are open, a flow-weighted relative velocity profile is computed independently for each port, and the velocity profiles are superimposed on the basis of a controlled shift of the withdrawal limits in the zone of overlap to achieve a total relative velocity profile.

Outflow

66. Using the velocity profile calculated by the selective withdrawal process, an estimate of the outflow quantity from each vertical layer of the reservoir can be made. The outflow process first removes the outflow from each layer creating voids that must be filled from the layers above. Beginning at the lowest layer from which outflow occurs, water from the layer above is used to fill the void created by the outflow. The temperature and quality of that layer are then calculated as a weighted average of the layer and its characteristics and the amount filled by the layer above and its characteristics. Now the layer above has a void created by this refilling process as well as perhaps a void created by the withdrawal process. This layer must now be refilled from above. This refilling process is repeated sequentially for all layers until the surface is reached. A decrease in the surface elevation occurs as a result of the outflow simulation process.

PART IV: WESTEX COMPUTER CODE DESCRIPTION

67. The general simulation process of the WESTEX model was shown in Figure 4. Figure 5 shows the sequence of subprograms that are used to represent this general simulation process. The WESTEX program uses a modular design such that each of the steps in the simulation process is performed by one or more individual subprograms. Version 3.0 of the WESTEX model is written in ANSI standard FORTRAN 77 and is designed to run on all computer hardware platforms from mainframe to personal computer. For personal computer application, minimum hardware requirements are an IBM-compatible AT machine with a mathematical coprocessor.

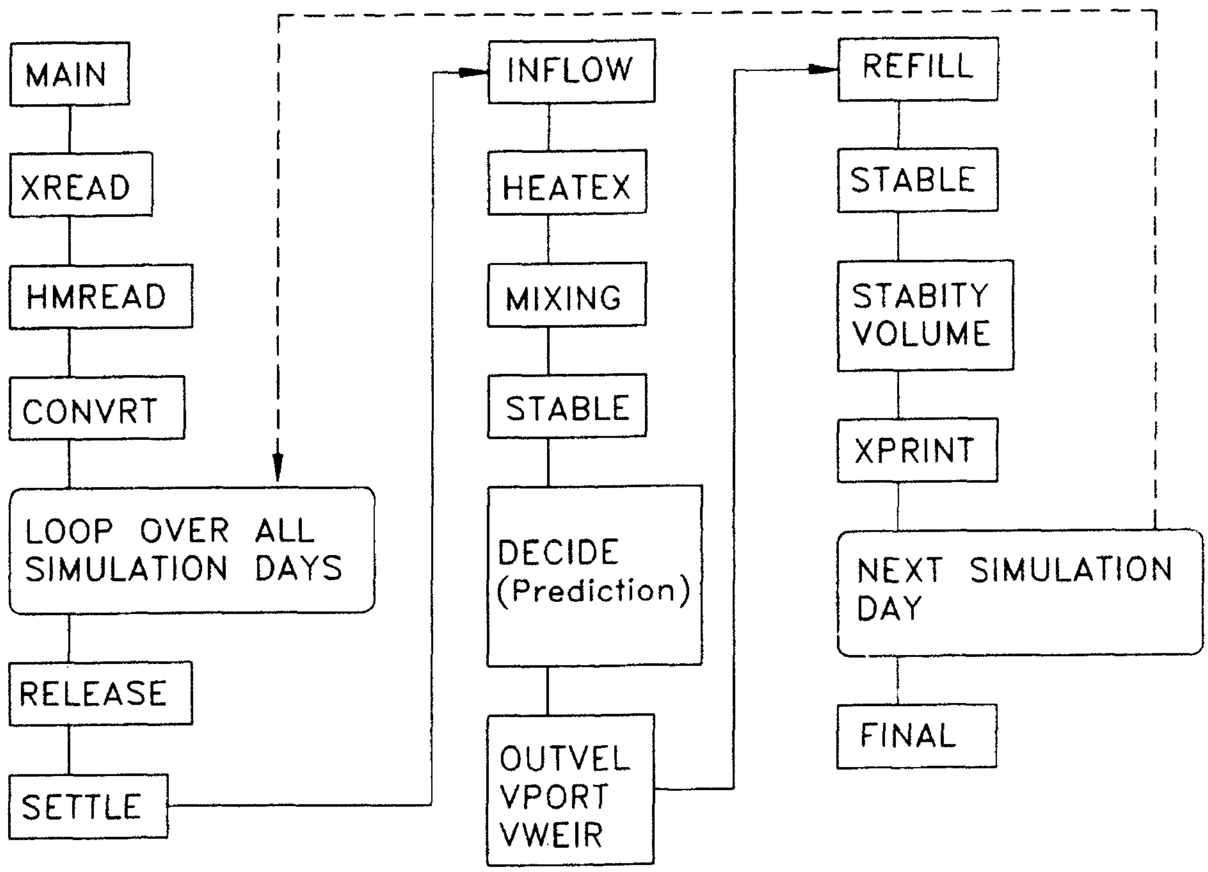

Figure 5. Sequence of subprograms in WESTEX

68. As illustrated in Figure 5, the main program in WESTEX controls the sequence in which the subprograms are executed. Subroutine XREAD is called first by the main program to read information concerning program control, impoundment characteristics, and outlet characteristics. Subroutine HMREAD is used next to read required hydrologic and meteorologic information.

Subroutine CONVRT is used to convert the units of the input data in cubic feet per second and degrees Fahrenheit to a consistent set of KACF* and degrees Celsius units for the computations. Subroutine CONVRT is also used to convert the results back into the user-desired units for output.

69. Once the input has been read, the program executes the main computational loop over all days to be simulated. The computations consider four basic heat budget processes: inflow, outflow, surface heat exchange, and internal mixing. The program first uses subroutine INFLOW to add the inflow to the reservoir. The inflow is mixed with a portion of existing reservoir waters and placed in a layer corresponding to the resultant inflow density. Next subroutine HEATEX is called to calculate the surface heat exchange at the air-water interface. Subroutine MIXING is then used to simulate the internal mixing and diffusion processes in the reservoir. To ensure that a stable density stratification exists after the inflow, surface heat exchange, and internal mixing processes, subroutine STABLE is called.

70. The subroutines that calculate the outflow processes are called next. The WESTEX model can be run in either the VERIFICATION or PREDICTION mode. If the PREDICTION mode is used, the user specifies only the total desired release and the target release quality. The WESTEX program uses subroutine DECIDE to select the ports to be operated and the discharge from each port. Once the outlet operation has been specified, subroutine OUTVEL is used to calculate the withdrawal from each layer of the impoundment and to calculate the release quality. Subroutine REFILL is then used to adjust the reservoir volume for the effects of withdrawal and subroutine STABLE is again called to ensure a stable stratification. To output daily information, subroutine XPRINT is used. After the last day of simulation, subroutine FINAL is used to output final summary information for the run and to create files for plotting.

71. A summary of the functions of each of the subprograms is given in Table 2. A detailed description of the FORTRAN variables used in the various subroutines and a full listing of the WESTEX program code is available in a companion programmer's manual (Fontane et al. 1993).

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* Thousands of acre-feet per day.

Table 2

Functions of the WESTEX Subprograms

Subprogram	Function
MAIN	Controls overall program logic flow
CONVRT	Converts units from cubic feet per second to KACF and from degrees F to degrees C
DECIDE	Determines the best combination of outlets and flows to meet release target temperature
DETAIL	Prints detailed information and line plots for user-specified days
DENINT	Computes density as a function of temperature and possibly other qualities
FINAL	Prints final summary output
HEATEX	Computes heat exchange at the air-water interface and distributes short-wave radiation with depth
HMREAD	Reads hydrologic and meteorologic input
INFLOW	Computes entrainment and places inflow into the reservoir
LINPLT	Creates printer plots of profiles of temperature, qualities, withdrawal velocities, and outflows
MIXING	Computes the internal mixing and diffusion processes
OUTVEL	Initializes the computation of the zone of withdrawal and withdrawal profile
REFILL	Refills the layers after the withdrawal process
SETTLE	Adjusts appropriate quality concentrations to account for settling. This is used for suspended solids as an example.
STABLE	Ensures that a stable density profile exists
STABITY	Evaluates the strength of the density stratification
TPLOT	Writes profile and summary output to a file for plotting
VPORT	Computes selective withdrawal velocities for port flow
VWEIR	Computes selective withdrawal velocities for weir flow
XFIRST	Prints the controlling parameter input values used in the simulation run
XPRINT	Prints the results for each day of simulation
XREAD	Reads the controlling information and reservoir physical characteristics for the simulation
VOLUME	Calculates the volume in the top layer of the reservoir

PART V: INPUT DATA AND OUTPUT OF RESULTS

Input Data

72. To assist model users to better understand the overall use of the WESTEX model, Appendix A lists reports developed by WES and field offices based upon applications of the WESTEX model to various Corps of Engineers projects. Examples of input data files for the WESTEX model are provided in Appendices B, C, and D. The examples in Appendices B and C are for a PREDICTION mode simulation. Appendix D contains an example for a VERIFICATION mode simulation. The format of the input is designed such that the name of the variable being read is placed on the line of input or on a separate line preceding the data. The program checks the variable to be read to ensure that all input lines are in order. If the lines of input are not in order, the program will print an error code that denotes the input line it was reading when it encountered the error. These error codes are listed in Appendix H.

73. The input data will first be described for the example data set for a PREDICTION run shown in Appendix B. Then variations of that input as shown in Appendix C will be described. Finally, the modifications needed to describe the data set for the VERIFICATION run shown in Appendix B will be discussed.

74. The program is designed to read one full set of data, which is usually one year. As an example, consider the data set for a PREDICTION mode run shown in Appendix B. This data set illustrates an example for simulating the temperature and suspended solids distribution within a reservoir with two inflow points and a selective withdrawal outlet structure containing five ports in two wet wells and a floodgate. Note that the control names of the input variables should be entered exactly as shown in the example. The following input is used:

INPUT 1: [FORMAT (A78)] Title for the run.

INPUT 2: [FORMAT (A4,6X,14I5)] File specifications for input and output. Usually input is 5 and output is 6.

INPUT 3: [FORMAT (A4,6X,14I5)] Echo print input data. PRINT will cause the echo print and NOPRINT will suppress it.

INPUT 4: [FORMAT (A4,6X,3(A4,6X))] Write Plot files. NOPLOT will suppress these files. PLOT RELEASE PROFILES will create a plotting file

named POUT that contains both summary release temperature and qualities and profile data.

INPUT 5: [FORMAT (A4,6X,3(A4,6X))] Enter mode, either PREDICTION or VERIFICATION.

INPUT 6: [FORMAT (A4,6X,I5,5X,3(A4,6X))] Enter the number of qualities to be simulated in addition to temperature.

INPUT 7: [FORMAT (A4,6X,14I5)] Enter the number of inflow points to the reservoir for which data will be provided.

INPUT 8: [FORMAT (A4,6X,14I5)] Enter the maximum number of vertical layers to be used.

INPUT 9: [FORMAT (A4,6X,7F10.0)] Enter the thickness of the vertical layers in feet.

INPUT 10: [FORMAT (A4,6X,7F10.0)] Enter the elevation of the bottom of the reservoir in feet referred to mean sea level (msl).

INPUT 11: [FORMAT (A4,46X,A4,6X,6X,A4)] Enter VOLUME and type. Volume is in KACF. If type is INCREMENT then incremental layer volumes are assumed. Otherwise total volumes are assumed.

INPUT GROUP 12: [FORMAT (8F10.0)] This contains the layer volumes in the form and units specified with INPUT 11. The number of lines of input will correspond to the number of layers specified with INPUT 8.

INPUT 13: [FORMAT (A4,6X,14I5)] Enter WIDTH.

INPUT GROUP 14: [FORMAT (8F10.0)] This contains the layer widths. These are not needed except in unusual cases and the value of 1.0 can be used for each width. The number of lines of input will correspond to the number of layers specified with INPUT 8.

INPUT 15: [FORMAT (A4,6X,14I5)] Enter PORT and the number of ports.

INPUT 16: [FORMAT (A4,6X,7F10.0)] Enter AREA and beginning with the highest port in the pool, enter the area of each port in square feet.

INPUT 17: [FORMAT (A4,6X,7F10.0)] Enter ANGLE and beginning with the highest port in the pool, enter the withdrawal angle of each port in radians relative to the structure. This is usually equal to 3.14.

INPUT 18: [FORMAT (A4,6X,7F10.0)] Enter HEIGHT and beginning with the highest port in the pool, enter the height of each port above the bottom in feet.

INPUT 19: [FORMAT (A4,6X,7F10.0)] Enter MINIMUM and beginning with the highest port in the pool, enter the minimum discharge allowable from each port in cfs.

INPUT 20: [FORMAT (A4,6X,7F10.0)] Enter MAXIMUM and beginning with the highest port in the pool, enter the maximum discharge allowable from each port in cfs.

INPUT 21: [FORMAT (A4,6X,14I5)] Enter WETWELL and beginning with the highest port in the pool, enter the number of the wet well where each port is located.

INPUT 22: [FORMAT (A4,6X,7F10.0)] Enter SELMAX and the maximum discharge allowable through the selective withdrawal structure.

INPUT 23: [FORMAT (A4,6X,7F10.0)] Enter FLOODGATE and in following order the area, height above the bottom, minimum flow, maximum flow, and withdrawal angle for the flood gate.

INPUT 24: [FORMAT (A4,6X,7F10.0)] Enter HEAT and the short-wave solar radiation absorption parameters.

INPUT 25: [FORMAT (A4,6X,7F10.0)] Enter MIXING and the internal mixing coefficients.

INPUT 26: [FORMAT (A4,6X,7F10.0)] Enter ENTRAN and the entrainment proportion from the surface layer.

INPUT 27: [FORMAT (A4,6X,7F10.0)] Enter DENC and the specific gravity of all quality constituents. A value of zero implies that the constituents do not influence density.

INPUT 28: [FORMAT (A4,6X,7F10.0)] Enter SETV and the settling velocity for the quality constituents. A value of zero implies no settling.

INPUT 29: [FORMAT (A4,6X,14I5)] Enter INTERVAL and the Julian day number of the beginning day of data input and the ending day of data input. For a full year these values are 1 and 365.

INPUT 30: [FORMAT (A4,6X,14I5)] Enter SIMULATE and the Julian day number of the beginning day of simulation and the ending day of simulation. For a full year these values are 1 and 365.

INPUT 31: [FORMAT (A4,6X,14I5)] Enter PRINT DAYS and the Julian day number of the selected days for which detailed printout information is required. Information for the plot file will also be created if PLOT was specified in INPUT 4.

INPUT 32: [FORMAT (A4,46X,A4,6X,A4)] Enter TARGET temperatures and units. Units will be either FAHRENHEIT or CELSIUS.

INPUT GROUP 33: [FORMAT (8F10.0)] Enter the release target temperatures for each day of input data specified in INPUT 29.

INPUT 34: [FORMAT (A4,6X,7F10.0)] Enter DEPTH and the initial depth in feet above the bottom.

INPUT 35: [FORMAT (A4,46X,A4,6X,A4)] Enter the initial TEMPERATURE profile and units. The profile is entered from the bottom layer to the top layer. Units will be either FAHRENHEIT or CELSIUS.

INPUT GROUP 36: [FORMAT (8F10.0)] Enter the initial temperature for each layer specified in INPUT 8.

INPUT 37: [FORMAT (A4,46X,A4,6X,A4)] Enter the initial QUALITY profile and units. The profile is entered from the bottom layer to the top layer. Units will be MG/L.

INPUT GROUP 38: [FORMAT (8F10.0)] Enter the initial quality for each layer specified in INPUT 8.

************ REPEAT INPUT 37 AND INPUT GROUP 38 FOR ALL QUALITIES *********
************************* SPECIFIED IN INPUT 6. **************************

INPUT 39: [FORMAT (A4,36X,I4,2(6X,A4))] Enter the EQUILIBRIUM temperatures, the year, and the units. Units are in FAHRENHEIT.

INPUT GROUP 40: [FORMAT (8F10.0)] Enter the equilibrium temperatures for each day of input data specified in INPUT 29.

INPUT 41: [FORMAT (A4,46X,A4,6X,A4)] Enter the EXCHANGE coefficients and the units. Units are in BTU/DEG-F.

INPUT GROUP 42: [FORMAT (8F10.0)] Enter the exchange coefficients for each day of input data specified in INPUT 29.

INPUT 43: [FORMAT (A4,46X,A4,6X,A4)] Enter the SHORTWAVE radiation and the units. Units are in BTU/DEG-F.

INPUT GROUP 44: [FORMAT (8F10.0)] Enter the shortwave radiation values for each day of input data specified in INPUT 29.

INPUT 45: [FORMAT (A4,46X,A4,6X,A4)] Enter the WINDSPEED, and the units. Units are in MPH.

INPUT GROUP 46: [FORMAT (8F10.0)] Enter the wind speed values for each day of input data specified in INPUT 29.

INPUT 47: [FORMAT (A4,36X,I4,2(6X,A4))] Enter the INFLOW QUANTITY, the year, the units and data type. Units are either KACF or CFS. Type equal to MONTH will read monthly average inflows then dissaggregate them to daily values.

INPUT GROUP 48: [FORMAT (8F10.0)] Enter the inflow quantity values for each day of input data specified in INPUT 29 or 12 values if type MONTH was used.

INPUT 49: [FORMAT (A4,46X,A4,6X,A4)] Enter the TEMPERATURE INFLOW, the units, and data type. Units are either FAHRENHEIT or CELSIUS. Type equal to MONTH will read monthly average temperatures then dissaggregate them to daily values.

INPUT GROUP 50: [FORMAT (8F10.0)] Enter the inflow temperature for each day of input data specified in INPUT 29 or 12 values if type MONTH was used.

INPUT 51: [FORMAT (A4,46X,A4,6X,A4)] Enter the QUALITY of the INFLOW, the units and data type. Units are MG/L. Type equal to MONTH will read monthly average quality then dissaggregate them to daily values.

INPUT GROUP 52: [FORMAT (8F10.0)] Enter the inflow quality values for each day of input data specified in INPUT 29 or 12 values if type MONTH was used.

************ REPEAT INPUT 51 AND INPUT GROUP 52 FOR ALL QUALITIES ***********
*************************** SPECIFIED IN INPUT 6. ****************************

************ REPEAT INPUT 47 THROUGH INPUT GROUP 52 FOR ALL INFLOW **********
************************** POINTS SPECIFIED IN INPUT 7. *********************

INPUT 53: [FORMAT (A4,46X,A4,6X,A4)] Enter the total OUTFLOW QUANTITY, the units, and data type. Units are either KACF or CFS. Type equal to MONTH will read monthly average outflows then dissaggregate them to daily values.

INPUT GROUP 54: [FORMAT (8F10.0)] Enter the total outflow quantity for each day of input data specified in INPUT 29 or 12 values if type MONTH was used.

INPUT GROUP 55: [FORMAT (A4,46X,A4,6X,A4)] Enter STOP. This is the final required input.

75. The output from the WESTEX model based upon using the example input data of Appendix B is shown in Appendix E.

76. Appendix C illustrates several variations of the input data just described. The first of these is the use of harmonic functions to represent the release target temperature (INPUT 32) and the temperature of the inflow (INPUT 49). Note that for INPUT 32 and 49 a type of SINCURVE should be specified following units. The harmonic function has the following form:

$$\text{Temperature (Julian Day)} = A * \text{SIN}\,[B*(\text{JulianDay}) + C] + D$$

The values for INPUT 33 and INPUT 50 should now be the values for A, B, C, and D in the formats specified. Input 33 is the values of A, B, C and D corresponding to the sine curve equation representing the release target temperatures. Input 50 is the values of A, B, C and D corresponding to the sine curve equation representing the inflow temperatures.

77. A second variation illustrated in Appendix C is the use of monthly averaged values for reservoir inflows, qualities, and outflows. Note that in INPUT 47, 51, and 53, MONTH is specified to denote the use of monthly average values.

78. Another potential variation in the WESTEX model input is for the case when a weir is used as an outlet instead of a port. Although this is not demonstrated by example in the appendices, this situation would require the following inputs:

INPUT 15: [FORMAT (A4,6X,14I5)] Enter WEIR.

INPUT 16: [FORMAT (A4,6X,14I5)] Enter the WRTYPE. The weir type will be either FREE or SUBMERGED.

INPUT 17: [FORMAT (A4,6X,7F10.0)] Enter the WRLENGTH. The weir length is given in feet.

INPUT 18: [FORMAT (A4,6X,7F10.0)] Enter the WRHEIGHT. The height of the weir is given in feet above the bottom.

INPUT 19: [FORMAT (A4,6X,7F10.0)] Enter the DCOEFF. This is the discharge coefficient for the weir.

INPUT 20 - 23 are not used for a weir outlet.

INPUT 53: [FORMAT (A4,36X,I4,2(6X,A4))] Enter the WEIR FLOW QUANTITY and units. Units are either KACF or CFS.

INPUT GROUP 54: [FORMAT (8F10.0)] Enter the weir outflow quantity for each day of input data specified in INPUT 29.

79. Appendix D shows an example input data file for the VERIFICATION mode. The basic data are essentially the same as that shown in Appendix B except that only three ports are assumed to be present in the outlet structure. The VERIFICATION mode requires that the user specify the outflow from each outlet for each day of simulation. The changes required in this input data file compared to the input file for a PREDICTION mode simulation relate to the fact that the user is now specifying the exact operation of the selective withdrawal structure. The following changes in the input data file are required:

INPUT 19, 20, 21, 22, and 23 are eliminated.

INPUT 32 and INPUT GROUP 33 are eliminated.

INPUT 53 and INPUT GROUP 54 become the outflow quantity for each outlet.

INPUT 53 and INPUT GROUP 54 are repeated for each outlet specified in INPUT 15.

The output from the WESTEX model based upon using the VERIFICATION example input data of Appendix D is shown in Appendix F.

Output Information

80. Examples of WESTEX model output are provided in Appendices E and F. This output is formatted to be printed on a 132-character-per-line, standard line printer, and appropriate line printer control characters are included in the program output. The output consist of three major types of information. The output first begins with general header information. If PRINT INPUT was specified in INPUT 3, then an echo print of the input data will be provided. The first major type of information provided in the output is the summary for each day of simulation. This consists of a table showing for each day of simulation the Julian day, the pool elevation, the inflow temperature, the inflow quantity, the target release temperature, the predicted release temperature, the predicted release quality, the total outflow, and the release from each outlet in the withdrawal structure.

81. The second major type of output is detailed information for the Julian days specified in INPUT 31. For those selected days the general daily summary information previously described is first displayed in a sequential fashion and now includes additional information for that simulation day such as the equilibrium temperature, heat exchange coefficient, and shortwave solar radiation. This is followed by a table that displays the layers, depth of each layer, the inflow into each layer, the withdrawal and withdrawal velocity in each layer, the temperature of each layer, and the quality concentration of each layer. An *X* is used in this table to denote the location of outlets releasing water for that day. This table is then followed by a line printer plot that graphically represents the temperature and quality profiles for that day.

82. After all days of simulation are complete, the final major type of information is a summary of results for the entire simulation period. This summary is provided in the form of summary tables that display the Julian day and the specified parameter. The first summary table shows the release temperature, the second table shows the release quality, the third table shows

the port selection indices (these are used to denote the location within subroutine DECIDE that was used to select the number and location of outlets to be used for the release), and the fourth table shows the difference between the release temperature and the target temperature. Following these tables is a summary of statistics relating to the release temperature and the target temperature. These include the sum of the differences, the sum of the squared differences, the sum of the absolute differences, the average difference, the average absolute difference, the maximum difference, and the maximum change in release temperature from one day to the next that occurred during the simulation period. If the run is a VERIFICATION mode simulation, then the summary information contains only the first and second tables on release temperature and qualities. The other tables and statistics are omitted since they are not appropriate for the VERIFICATION mode.

83. If the user specifies PLOT in INPUT 4, then a plot file is created that contains the information specified in INPUT 4, specifically summary release temperatures and qualities or profiles for the selected days identified in INPUT 31 or both. If both releases and profiles are requested, the file contains the profiles in sequential order followed by the release values. An example of this plotting file, corresponding to the VERIFICATION results illustrated in Appendix F, is shown in Appendix G.

PART VI: SUMMARY

84. This report documents Version 3.0 of the WESTEX program for field office use. It contains descriptions of the in-reservoir processes, such as thermal stratification, inflow, and withdrawal (Part II), the computational methodologies and the sequence of operations in WESTEX (Parts III and IV, respectively), and the description of the required input data and format (PART V). The report also provides information on applications of the WESTEX model (Appendix A), examples of input files (Appendices B, C, and D), example output (Appendices E, F, and G), and program error codes (Appendix H). A programmer's manual (Fontane et al. 1993) gives a listing of the program code and definitions of program variables.

85. The appendices of this report provide information to potential users for setup and execution of the model. Inquiries concerning this model may be directed to Michael L. Schneider, Reservoir Water Quality Branch, Hydraulics Laboratory, US Army Engineer Waterways Experiment Station, at (601) 634-3424.

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APPENDIX A: CHRONOLOGICAL BIBLIOGRAPHY FOR APPLICATIONS OF WESTEX

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APPENDIX B: EXAMPLE INPUT FILE I: PREDICTION MODE

Note: A table of factors for converting non-SI units of measurement used in Appendices B-G to SI (metric) units is found on page 3 of the main text.

EXAMPLE INPUT FILE I: PREDICTION MODE

```
ANONYMOUS RESERVOIR EXAMPLE INPUT
DATA FILES    5    6
NOPRINT INPUT
PLOT       RELEASE   PROFILES
PREDICTION
QUALITIES     1
INFLOWS       2
LAYERS       60
THICKNESS       4.0
BOTTOM        1776.
VOLUME                                                   KACF       INCREMENT
  0.114     0.056     0.056     0.101     0.116     0.135     0.192     0.192
  0.279     0.308     0.337     0.424     0.424     0.526     0.560     0.595
  0.700     0.700     0.808     0.844     0.883     1.000     1.000     1.150
  1.200     1.240     1.360     1.360     1.540     1.600     1.640     1.760
  1.760     1.940     2.000     2.070     2.280     2.280     2.460     2.520
  2.600     2.840     2.840     3.020     3.080     3.150     3.360     3.360
  3.510     3.560     3.632     3.850     4.000     4.200     4.400     4.600
  4.800     5.000     5.200     5.400
WIDTH
   1.0       1.0       1.0       1.0       1.0       1.0       1.0       1.0
   1.0       1.0       1.0       1.0       1.0       1.0       1.0       1.0
   1.0       1.0       1.0       1.0       1.0       1.0       1.0       1.0
   1.0       1.0       1.0       1.0       1.0       1.0       1.0       1.0
   1.0       1.0       1.0       1.0       1.0       1.0       1.0       1.0
   1.0       1.0       1.0       1.0       1.0       1.0       1.0       1.0
   1.0       1.0       1.0       1.0       1.0       1.0       1.0       1.0
   1.0       1.0       1.0       1.0
PORTS         5
AREAS           30.0      30.0      30.0      50.0      50.0
ANGLE           3.14      3.14      3.14      3.14      3.14
HEIGHT          65.0     122.0     157.0     177.7     189.0
MINIMUM          1.0       1.0       1.0       1.0       1.0
MAXIMUM        300.0     300.0     300.0     500.0     500.0
WETWELL            1         2         1         2         1
SELMAX        1000.0    1000.0    1000.0    1000.0    1000.0
FLOODGATE       57.0       3.0       0.0    4500.0      3.14
HEAT            0.20      0.20
MIXING           20.    0.5E10
ENTRAIN         0.30
DENC       .00000062
SETV            0.00
INTERVAL      1  365
SIMULATE      1  365
PRINT DAYS  118  153  202  253  293
TARGET TEMPERATURES FOR THE RELEASE                      FAHR
  37.4      37.4      37.4      37.4      37.4      37.4      37.4      37.4
  37.4      37.4      37.4      37.4      37.4      37.4      37.4      37.4
  37.4      37.4      37.4      37.4      37.4      37.4      37.4      37.4
  37.4      37.4      37.4      37.4      37.4      37.4      37.4      37.4
  37.4      37.4      37.4      37.4      37.4      37.4      37.4      37.4
```

37.4	37.4	37.4	37.4	37.4	37.4	37.4	37.4
37.4	37.4	37.4	37.4	37.4	37.4	37.4	37.4
37.4	37.4	37.4	42.1	42.1	42.1	42.1	42.1
42.1	42.4	42.4	42.4	42.4	42.4	42.4	42.4
43.1	43.1	43.1	43.1	43.1	43.1	43.1	43.7
43.7	43.7	43.7	43.7	43.7	43.7	43.7	43.7
43.7	43.7	44.2	44.2	44.2	44.2	44.2	44.2
45.0	45.0	45.0	45.0	45.0	45.0	45.0	46.4
46.4	46.4	46.4	46.4	46.4	46.4	47.8	47.8
47.8	47.8	47.8	47.8	47.8	47.8	47.8	47.8
48.2	48.2	48.2	48.2	48.2	48.2	48.7	48.7
48.7	48.7	48.7	48.7	48.7	50.4	50.4	50.4
50.4	50.4	50.4	50.4	52.5	52.5	52.5	52.5
52.5	52.5	52.5	52.5	52.5	52.5	52.5	55.0
55.0	55.0	55.0	55.0	55.0	55.0	55.0	55.0
55.0	55.0	55.0	55.0	55.0	55.0	55.0	55.0
55.0	55.0	55.0	55.0	55.0	55.0	55.0	55.0
55.0	55.0	55.0	55.0	55.0	55.0	55.0	55.0
55.0	55.0	55.0	55.0	55.0	55.0	55.0	55.0
55.0	55.0	55.0	55.0	55.0	55.0	55.0	55.0
55.0	55.0	55.0	55.0	55.0	55.0	55.0	55.0
55.0	55.0	55.0	55.0	55.0	55.0	55.0	55.0
55.0	55.0	55.0	55.0	55.0	55.0	55.0	55.0
55.0	55.0	55.0	55.0	55.0	55.0	55.0	55.0
55.0	55.0	55.0	55.0	55.0	55.0	55.0	55.0
55.0	55.0	55.0	55.0	55.0	55.0	55.0	55.0
55.0	55.0	55.0	55.0	55.0	55.0	55.0	55.0
59.0	59.0	59.0	59.0	59.0	59.0	59.0	59.0
59.0	59.0	59.0	59.0	59.0	59.0	59.0	59.0
59.0	57.2	57.2	57.2	57.2	57.2	57.2	51.8
51.8	51.8	51.8	51.8	51.8	51.8	46.9	46.9
46.9	46.9	46.9	46.9	46.9	43.7	43.7	43.7
43.7	43.7	43.7	43.7	43.7	43.7	43.7	43.7
39.2	39.2	39.2	39.2	39.2	39.2	37.4	37.4
37.4	37.4	37.4	37.4	37.4	37.4	37.4	37.4
37.4	37.4	37.4	37.4	37.4	37.4	37.4	37.4
37.4	37.4	37.4	37.4	37.4	37.4	37.4	37.4
37.4	37.4	37.4	37.4	37.4	37.4	37.4	37.4
37.4	37.4	37.4	37.4	37.4	37.4	37.4	37.4
37.4	37.4	37.4	37.4	37.4	37.4	37.4	37.4
37.4	37.4	37.4	37.4	37.4			

DEPTH 125.8

TEMPERATURE - INITIAL CELSIUS

5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6
5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6
5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6
5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0				

QUALITY - INITIAL SUSPENDED SOLIDS MG/L

30.3	30.3	30.3	30.3	30.3	30.3	30.3	30.3
30.3	30.3	30.3	30.3	30.3	30.3	30.3	30.3

30.3	30.3	30.3	30.3	30.3	30.3	30.3	30.3
30.3	30.3	30.3	30.3	30.3	30.3	30.3	30.3
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0				

EQUILIBRIUM TEMPERATURE F-DEGREES 1992 FAHR

29.5	30.8	33.5	33.6	25.6	26.2	26.5	30.6
24.8	26.3	26.2	28.4	27.3	25.4	26.6	28.8
37.7	34.4	28.9	32.5	31.7	29.9	35.4	38.8
40.4	39.4	33.2	39.6	33.3	32.8	30.8	30.0
35.6	37.6	33.4	35.5	30.7	39.0	35.6	39.3
39.6	35.9	32.6	44.6	48.7	48.9	50.1	50.6
43.4	53.7	53.9	43.8	42.2	46.4	47.4	42.4
40.4	47.2	43.4	48.8	45.7	45.9	49.1	49.7
48.8	43.2	52.7	53.3	49.8	46.0	51.2	45.1
44.2	44.3	40.4	48.3	44.2	46.3	48.6	58.0
61.0	63.1	61.6	56.1	48.5	45.5	43.1	41.2
40.6	47.6	42.1	45.1	40.9	47.7	43.1	44.0
48.9	57.3	63.0	52.1	53.3	48.7	50.1	47.3
59.1	63.2	60.3	56.5	58.5	57.7	68.1	71.2
66.0	67.8	55.5	64.8	57.5	59.8	68.2	56.4
58.8	62.6	64.3	69.5	72.0	67.9	64.5	53.9
57.5	66.2	66.6	68.2	66.4	69.9	70.1	66.2
59.2	64.6	74.0	70.8	74.0	72.7	72.3	85.3
73.6	64.8	65.9	71.0	72.2	74.2	58.5	68.9
63.2	61.3	55.3	62.9	69.7	71.7	81.3	79.5
78.9	68.1	62.9	70.0	79.0	83.2	80.2	84.1
81.8	74.6	74.9	78.8	79.8	82.8	68.7	69.1
67.5	68.8	63.7	70.5	70.4	74.1	63.5	71.6
63.3	76.3	76.5	63.3	79.7	74.1	82.3	80.9
81.0	75.5	76.9	74.4	78.6	77.5	80.7	81.3
78.6	76.0	76.9	77.9	80.1	81.2	85.0	81.6
79.8	79.9	76.3	73.4	69.5	68.3	65.7	75.3
79.9	82.1	76.9	81.8	73.7	69.2	74.1	77.5
76.4	72.6	71.3	76.5	78.4	79.3	77.7	81.7
81.2	79.1	79.9	80.6	76.6	72.6	75.1	71.5
71.7	74.4	75.6	80.5	76.2	70.3	73.5	74.3
70.8	73.0	79.1	67.1	67.3	67.0	64.1	68.8
63.0	63.4	64.4	61.7	59.2	58.2	64.0	64.5
72.1	69.1	67.8	59.9	53.6	55.8	55.1	59.9
61.9	63.5	60.1	56.6	56.4	59.4	50.0	51.0
60.8	63.0	62.9	64.4	68.3	63.2	61.3	64.4
58.7	54.6	53.7	47.9	50.2	55.7	58.0	60.8
54.9	52.6	48.4	46.1	42.9	48.9	52.7	48.2
46.3	47.7	50.9	52.8	49.4	47.8	38.3	38.1
36.5	36.2	33.4	37.0	38.1	37.6	35.9	34.5
47.2	43.5	40.6	37.5	37.7	40.1	42.8	37.5
30.8	31.6	45.0	43.2	43.2	37.3	38.6	34.3
43.3	47.7	45.8	42.3	32.8	31.8	33.7	35.1
31.4	34.6	38.0	40.4	42.4	43.4	37.6	32.5
38.3	38.7	39.5	31.4	33.9	29.5	27.8	35.8
33.4	29.4	26.9	28.1	29.9			

EXCHANGE COEFFICIENTS BTU/DEG-F

55.8	72.4	66.1	66.1	31.0	45.5	28.7	29.6
29.1	31.4	29.4	39.8	39.4	31.2	31.4	29.8
42.5	50.3	31.7	40.5	48.3	40.0	33.4	31.9
44.4	79.8	40.8	42.8	40.5	40.5	32.3	40.0
32.7	33.0	68.0	46.0	30.8	32.2	40.0	41.1
40.7	40.1	31.9	65.9	59.5	70.1	90.6	88.9
55.0	51.1	87.5	65.5	61.1	42.9	43.6	33.7
61.9	46.0	111.4	118.4	73.4	54.2	55.5	44.7
44.0	43.4	58.8	48.9	48.0	63.9	54.7	53.9
74.1	52.1	51.7	44.8	53.6	44.5	63.5	46.7
48.6	49.7	61.4	80.5	95.4	63.3	61.1	51.2
69.9	63.8	42.7	119.1	70.0	63.1	70.2	61.1
54.7	57.3	60.6	48.2	135.2	105.6	98.9	73.8
57.5	60.3	83.7	66.4	57.6	116.2	74.6	67.9
77.2	79.2	58.6	62.8	59.2	93.3	64.5	69.9
72.4	75.7	87.8	64.5	68.5	81.1	101.7	87.1
69.6	76.2	64.3	80.2	79.9	82.3	67.1	92.5
97.8	87.4	71.1	85.9	107.6	88.4	72.5	69.3
122.3	96.8	86.1	80.8	80.7	83.8	97.9	93.8
108.9	73.1	72.3	77.0	94.6	82.7	61.6	77.6
97.2	87.0	106.0	86.5	81.7	87.8	99.7	89.6
107.8	117.0	102.5	103.6	99.3	82.9	89.1	92.0
109.6	103.9	85.1	76.6	106.9	92.3	93.7	85.9
67.5	94.0	96.0	93.5	81.0	77.0	87.4	104.5
86.0	114.9	95.6	88.0	78.6	98.1	103.2	105.1
116.3	109.3	94.0	94.3	100.5	104.8	92.4	105.4
122.8	125.5	136.8	125.4	114.2	70.5	83.3	93.7
81.9	85.7	66.9	106.7	124.8	88.0	92.3	78.2
94.9	110.7	115.6	75.5	79.7	82.0	82.5	86.8
86.3	84.8	80.6	82.6	93.6	100.3	74.8	73.5
107.5	76.0	78.4	66.3	78.2	88.3	74.6	75.3
87.3	75.4	65.3	100.0	67.6	67.4	99.5	69.8
85.4	73.5	77.0	79.2	81.4	66.0	68.5	55.6
59.9	71.1	104.7	90.3	72.9	74.9	84.8	62.1
51.0	52.1	50.9	75.5	61.5	50.3	58.9	58.5
64.5	53.3	65.7	53.9	43.1	53.0	40.7	42.0
63.2	69.8	45.7	52.3	36.5	88.2	128.5	80.6
50.5	72.8	57.4	45.1	32.4	49.0	61.0	36.1
44.7	34.8	36.1	49.0	36.9	46.2	42.0	42.2
41.3	30.1	40.1	32.8	32.7	40.4	32.1	41.6
69.2	103.5	44.2	43.0	43.2	61.4	61.7	41.5
32.0	40.7	96.3	85.0	74.6	43.1	51.8	33.2
55.3	48.2	34.2	54.8	40.9	48.1	40.2	32.6
32.0	42.1	34.3	98.8	103.4	86.5	61.2	41.5
34.3	53.4	81.0	41.0	49.9	39.8	31.7	33.5
64.6	38.7	30.6	30.9	39.0			

SHORT WAVE RADIATION BTU/DEG-F

260.0	261.3	261.8	263.3	352.8	712.4	693.5	581.6
273.1	274.7	276.4	278.6	281.2	284.0	286.1	287.8
383.2	291.7	296.8	398.0	403.0	305.8	306.1	307.8
310.7	421.9	322.9	623.9	442.1	446.9	342.4	348.0
667.2	677.6	1007.9	1023.2	499.5	815.4	826.1	835.7
1089.7	766.3	403.7	400.0	400.9	407.1	415.1	914.5

427.8	569.7	575.9	443.7	879.7	1287.8	1275.2	784.7
476.6	644.2	487.5	950.5	830.2	681.3	992.3	1135.3
1024.7	532.0	716.2	535.8	541.0	747.9	1500.9	567.6
571.0	788.0	592.6	989.1	604.8	820.9	1349.7	1764.1
1777.9	1795.5	1807.5	1718.0	884.3	665.1	908.8	681.6
685.2	1150.5	699.6	1171.8	710.0	1195.9	977.9	987.4
991.7	1762.6	2109.7	741.6	1012.3	758.8	760.6	1044.3
1994.2	2223.9	2102.4	1748.8	1564.0	2296.1	2300.8	2294.0
1941.7	2300.2	824.7	1823.5	839.2	2008.0	2351.1	853.0
1153.6	1667.6	2385.9	2474.1	2412.0	1908.0	2345.0	1488.4
1491.2	2476.5	1970.2	2135.6	1750.7	2149.8	1998.5	1770.4
1522.4	2348.9	2593.3	2005.7	2562.3	2190.5	1803.3	2594.8
2607.8	2667.4	2635.1	2665.2	2552.0	2694.0	943.1	2425.3
2656.9	1600.1	949.2	1592.3	2695.0	2575.7	2671.8	2569.0
2542.9	943.4	1288.4	1855.6	2544.9	2676.7	2689.5	2672.3
2513.0	1261.9	1254.8	2052.1	2690.2	2711.0	941.3	934.0
923.4	1572.1	936.9	1269.6	1564.5	2068.6	1282.5	2269.8
943.4	2649.3	2389.3	939.3	2604.8	1559.0	2481.6	2609.6
2198.2	2182.7	2599.0	2640.1	2624.0	2176.3	2555.2	2558.5
2562.9	2555.0	2552.1	2548.7	2535.6	2373.5	2477.7	2474.5
2468.6	2445.6	2381.8	2321.5	2223.2	1455.5	1169.9	2292.4
2420.6	2397.9	834.9	2111.7	2337.9	1385.1	2104.0	233[illegible].5
2308.5	1755.5	2281.9	2281.4	2265.3	2227.5	1523.7	2198.8
2184.5	1675.6	2169.6	2160.5	2106.2	2138.4	2089.0	1450.7
1955.8	2061.1	2050.0	1924.0	1566.7	1379.7	1984.7	1968.0
1762.7	1629.3	1916.9	1592.3	1864.5	1698.6	876.7	1847.5
1854.3	1732.9	1513.0	845.6	613.1	611.3	1321.5	996.2
1661.8	1557.4	1438.6	951.0	571.1	562.4	749.3	1559.7
1509.9	1489.7	1038.5	523.0	866.1	1221.7	509.0	679.7
1360.0	1367.8	1360.1	1343.4	1321.1	1100.1	619.2	986.9
980.8	1124.9	1123.8	599.4	433.5	419.9	413.5	1062.9
670.2	400.7	657.9	530.2	522.1	379.6	862.0	616.8
958.4	983.4	887.4	578.5	571.4	743.0	658.8	556.2
775.8	769.3	631.4	698.5	832.5	875.8	776.6	307.7
396.5	397.2	392.9	293.5	290.0	383.9	739.3	786.4
376.5	280.4	273.6	359.9	269.9	269.0	438.8	266.3
262.0	551.1	255.9	552.0	557.1	425.1	709.7	703.5
621.8	253.3	331.7	251.9	249.4	247.3	330.1	250.6
248.6	248.0	249.0	251.0	332.2	481.7	253.6	251.5
649.2	704.2	708.2	709.3	710.5			

WIND SPEED MPH

6.0	8.0	7.0	7.0	2.0	5.0	2.0	2.0
2.0	2.0	2.0	3.0	3.0	2.0	2.0	2.0
3.0	5.0	2.0	3.0	5.0	3.0	2.0	2.0
3.0	8.0	3.0	3.0	3.0	3.0	2.0	3.0
2.0	2.0	8.0	5.0	2.0	2.0	3.0	3.0
3.0	3.0	2.0	6.0	5.0	6.0	8.0	8.0
5.0	3.0	7.0	6.0	6.0	3.0	3.0	2.0
6.0	3.0	12.0	12.0	7.0	5.0	5.0	3.0
3.0	3.0	5.0	3.0	3.0	6.0	5.0	5.0
7.0	5.0	5.0	3.0	5.0	3.0	6.0	3.0
3.0	3.0	5.0	7.0	9.0	6.0	6.0	5.0
7.0	6.0	3.0	13.0	7.0	6.0	7.0	6.0
5.0	5.0	5.0	3.0	13.0	10.0	9.0	7.0

5.0	5.0	7.0	6.0	5.0	12.0	6.0	5.0
6.0	6.0	5.0	5.0	5.0	8.0	5.0	6.0
6.0	6.0	7.0	5.0	5.0	6.0	8.0	8.0
6.0	6.0	5.0	6.0	6.0	6.0	5.0	7.0
8.0	7.0	5.0	6.0	7.0	6.0	5.0	3.0
8.0	8.0	7.0	6.0	6.0	6.0	8.0	7.0
9.0	6.0	6.0	6.0	7.0	6.0	3.0	5.0
6.0	6.0	8.0	6.0	5.0	5.0	6.0	5.0
6.0	7.0	6.0	6.0	6.0	5.0	6.0	6.0
7.0	7.0	6.0	5.0	7.0	6.0	7.0	6.0
5.0	6.0	6.0	7.0	5.0	5.0	5.0	6.0
5.0	7.0	6.0	6.0	5.0	6.0	6.0	6.0
7.0	7.0	6.0	6.0	6.0	6.0	5.0	6.0
7.0	7.0	8.0	8.0	8.0	5.0	6.0	6.0
5.0	5.0	3.0	6.0	8.0	6.0	6.0	5.0
6.0	7.0	8.0	5.0	5.0	5.0	5.0	5.0
5.0	5.0	5.0	5.0	6.0	7.0	5.0	5.0
7.0	5.0	5.0	3.0	5.0	6.0	5.0	5.0
6.0	5.0	3.0	7.0	5.0	5.0	7.0	5.0
7.0	6.0	6.0	6.0	6.0	5.0	5.0	3.0
3.0	5.0	7.0	7.0	6.0	6.0	7.0	5.0
3.0	3.0	3.0	6.0	5.0	3.0	5.0	5.0
5.0	3.0	5.0	3.0	2.0	3.0	2.0	2.0
5.0	6.0	3.0	5.0	2.0	7.0	10.0	6.0
3.0	6.0	5.0	3.0	2.0	3.0	5.0	2.0
3.0	2.0	2.0	3.0	2.0	3.0	3.0	3.0
3.0	2.0	3.0	2.0	2.0	3.0	2.0	3.0
6.0	10.0	3.0	3.0	3.0	6.0	6.0	3.0
2.0	3.0	9.0	8.0	7.0	3.0	5.0	2.0
5.0	3.0	2.0	5.0	3.0	5.0	3.0	2.0
2.0	3.0	2.0	10.0	10.0	8.0	6.0	3.0
2.0	5.0	8.0	3.0	5.0	3.0	2.0	2.0
7.0	3.0	2.0	2.0	3.0			

INFLOW QUANTITY FROM INFLOW POINT - 1 1992 CFS

858.40	732.00	700.80	711.70	629.30	561.20	526.10	475.90
455.80	439.00	437.20	427.90	414.30	406.10	384.10	372.50
393.90	407.70	381.60	367.40	346.60	325.50	323.90	331.10
345.70	465.90	429.00	400.50	366.80	352.40	335.10	311.90
299.50	291.20	276.70	256.60	251.10	243.20	232.60	232.40
214.53	209.20	196.30	670.30	3195.00	2795.00	3670.00	2397.00
1483.60	2200.40	2070.00	2682.00	1835.20	1379.20	1140.00	981.20
877.50	777.90	688.10	1192.00	1132.50	993.70	859.60	777.10
708.40	660.00	611.90	612.60	614.60	690.30	621.00	575.90
550.50	498.50	487.70	461.00	436.90	404.70	381.80	369.30
361.10	343.60	339.80	341.70	337.70	333.50	346.20	313.10
348.80	356.00	320.40	351.30	350.80	327.50	325.50	317.60
297.80	297.00	304.30	403.00	1163.90	1139.20	1400.80	1294.70
970.60	811.90	732.20	678.20	647.20	656.00	706.40	830.40
982.10	1020.70	984.00	934.30	876.70	887.10	860.70	845.30
861.70	835.00	834.30	813.80	778.90	832.50	920.40	848.80
706.80	617.90	566.50	579.30	624.60	669.50	660.50	663.30
715.30	679.90	608.60	607.50	745.40	771.40	743.80	780.10
842.70	747.70	570.90	488.40	446.10	428.30	417.80	400.00
381.10	357.60	355.60	311.00	284.00	276.60	280.10	279.50

299.90	314.40	285.70	276.80	275.20	278.90	275.40	259.30
252.50	370.00	326.00	242.00	208.98	186.30	173.60	159.11
205.03	239.90	220.50	279.40	211.16	177.05	164.49	150.30
137.44	128.62	119.36	114.92	109.25	102.79	100.78	97.80
91.08	85.22	83.73	73.73	70.29	71.02	68.88	65.11
63.02	58.83	59.51	57.11	57.65	54.55	56.68	51.98
54.54	50.31	49.68	49.06	44.90	46.23	44.91	45.64
42.80	43.47	44.42	39.55	37.19	35.65	36.75	34.82
35.02	34.79	35.47	33.74	32.43	30.90	30.92	32.46
30.06	30.70	28.54	28.28	25.04	25.08	25.30	25.52
31.61	24.14	28.76	28.34	26.83	28.34	25.51	26.16
26.42	24.45	24.42	24.70	21.50	23.34	23.15	24.87
24.86	22.70	28.85	26.99	35.77	40.18	31.98	33.08
32.75	32.84	37.57	33.77	34.36	43.71	37.67	40.83
38.55	35.07	35.71	35.60	36.16	34.02	47.64	47.55
35.00	33.54	32.08	35.07	34.49	37.28	36.47	34.69
32.74	33.83	35.43	37.93	36.99	54.78	109.69	125.54
74.25	75.95	124.11	85.55	71.49	526.40	299.90	136.28
95.02	78.04	68.84	65.54	65.34	67.81	58.01	63.72
62.42	58.90	59.67	61.49	58.80	55.12	50.60	56.12
184.45	597.00	357.30	221.07	174.71	146.32	137.20	124.43
113.85	115.30	139.58	300.44	503.30	385.80	277.45	248.24
452.30	894.80	875.90	832.50	515.00	378.80	306.10	267.25
226.73	220.22	201.43	214.08	853.40	2921.00	1999.90	1123.00
882.40	928.90	1105.90	930.30	671.10	526.60	450.00	416.20
365.70	328.40	305.90	283.20	262.80			

TEMPERATURE INFLOW FOR INFLOW POINT - 1 CELSIUS

4.65	3.80	3.70	4.20	4.10	3.20	2.70	3.75
4.20	4.40	4.40	4.25	3.75	3.95	4.05	4.65
5.10	4.10	3.65	4.05	3.70	3.75	4.85	5.05
5.15	4.50	4.15	4.55	3.90	4.05	3.95	3.52
3.77	4.09	3.48	3.44	3.72	3.23	3.21	3.98
4.00	4.00	3.30	3.68	4.01	5.76	5.44	5.61
5.86	5.31	5.65	5.67	5.25	4.38	4.73	4.75
5.00	5.35	5.35	5.50	5.20	5.20	5.35	5.00
5.05	5.30	6.20	6.80	6.60	6.00	4.90	5.60
5.75	4.65	4.40	4.25	4.70	4.85	4.60	4.70
5.15	5.55	6.05	6.40	6.35	5.90	4.50	4.20
3.00	3.00	3.65	3.65	3.50	4.25	4.05	3.95
4.80	5.05	5.40	5.55	5.35	5.60	5.80	5.45
5.20	5.70	6.30	6.25	6.10	6.55	6.80	7.05
6.90	6.70	6.65	6.50	6.90	6.95	6.50	7.20
6.85	7.05	7.20	6.75	7.15	7.50	7.35	6.10
5.90	6.70	7.05	7.75	7.90	7.95	7.65	8.00
7.30	7.10	7.60	8.60	9.00	8.45	8.55	9.05
9.40	8.15	7.50	7.90	8.60	8.95	8.75	9.15
8.45	7.70	7.45	7.60	8.80	9.45	9.55	10.60
11.60	11.15	10.75	11.00	11.40	12.45	13.00	13.40
13.75	13.40	13.15	13.95	13.90	14.00	14.10	13.80
13.60	13.40	12.35	11.95	12.50	12.70	12.40	12.00
11.60	12.65	13.65	13.25	13.60	13.95	14.50	15.55
15.65	15.65	15.75	14.65	14.15	15.35	16.40	16.80
16.85	16.50	16.30	16.15	16.75	17.25	17.75	17.85
18.20	18.50	19.00	18.45	17.00	15.50	14.85	15.95

16.25	17.00	16.90	18.15	17.85	16.75	16.75	16.05
16.25	16.35	16.45	15.85	16.05	16.45	17.25	17.35
17.35	17.80	18.00	17.65	17.55	16.70	16.59	15.71
15.93	15.81	15.80	15.95	16.25	16.05	14.90	14.90
15.15	15.05	15.65	15.35	14.30	13.00	14.40	13.95
12.95	11.85	12.00	12.40	12.20	12.35	11.60	11.85
12.50	12.85	14.05	13.20	11.50	11.50	11.75	10.90
9.80	9.70	10.00	11.45	10.85	9.80	9.65	8.95
9.30	9.25	9.35	9.55	9.70	9.80	10.10	10.30
10.20	10.05	8.40	7.95	9.05	10.10	10.40	10.30
9.80	10.15	8.50	7.40	6.75	7.75	8.10	6.70
6.50	5.30	5.75	6.80	6.55	6.95	5.25	4.95
4.75	3.45	3.00	3.35	2.95	2.30	2.10	3.05
5.35	5.00	3.80	4.25	4.50	4.35	4.50	3.50
3.60	4.10	5.40	5.40	5.15	4.45	4.35	4.55
5.45	5.50	5.80	5.00	3.90	3.05	3.05	3.20
3.25	4.05	4.25	4.40	4.55	5.35	4.95	4.95
5.20	4.59	4.93	4.46	4.23	4.07	3.87	4.25
4.05	2.65	2.15	2.20	2.30			
QUALITY FOR INFLOW POINT-1 SUSPENDED SOLIDS MG/L							
8.31	7.67	5.69	6.02	5.05	4.11	3.53	3.13
3.19	1.07	1.62	3.06	2.64	2.44	2.15	2.06
2.01	1.99	1.91	1.72	1.52	1.31	1.19	0.35
0.58	2.72	1.71	1.22	1.03	0.92	0.83	0.72
0.61	0.24	0.63	0.52	0.52	0.39	0.40	0.40
0.27	0.98	1.00	27.88	87.40	107.84	87.53	28.48
19.92	30.36	36.15	113.29	62.77	25.37	16.69	12.65
9.69	8.03	7.16	33.82	20.70	8.19	5.93	5.11
4.69	4.47	3.91	3.48	3.38	1.58	2.85	2.56
2.60	2.40	2.42	1.96	2.01	1.74	1.56	1.46
1.36	1.39	1.27	1.26	1.15	1.15	0.67	1.06
0.91	1.23	1.06	1.01	0.80	1.28	1.06	0.95
0.86	0.63	0.85	3.25	21.63	10.39	11.64	5.40
2.45	4.10	4.27	2.06	1.71	1.78	1.83	2.78
3.93	3.81	3.01	2.53	2.42	2.74	2.37	2.71
2.94	2.97	3.21	3.01	3.03	3.75	4.17	3.43
2.73	3.01	2.56	2.46	2.81	3.41	3.42	3.52
3.54	2.98	2.84	3.28	4.54	5.49	4.86	5.72
7.73	6.07	4.26	5.60	4.60	3.03	2.75	2.49
2.33	2.06	2.09	2.33	1.56	1.45	1.43	1.42
1.83	2.13	2.12	1.89	1.88	1.87	2.00	1.92
2.32	3.91	4.11	3.48	2.12	1.95	1.29	2.87
1.72	1.26	0.92	3.30	1.19	0.99	0.89	0.92
0.96	0.98	1.01	1.19	1.05	1.24	1.25	1.28
1.31	1.35	1.35	1.40	1.43	1.42	1.44	1.68
1.70	1.76	1.54	1.79	1.79	1.83	1.81	1.87
1.82	1.88	1.88	1.90	1.95	0.72	0.73	0.73
0.75	0.99	0.98	0.77	1.05	1.07	0.53	0.81
1.07	0.80	1.07	1.08	0.82	1.12	1.12	1.10
1.14	1.12	1.16	1.16	1.21	1.21	1.20	1.20
0.84	0.92	0.86	0.87	0.89	1.16	0.91	0.90
1.20	0.92	0.92	1.22	1.61	0.93	0.93	0.92
1.22	0.95	0.87	0.89	1.37	1.58	1.41	1.10
1.11	0.83	1.32	0.82	0.82	1.59	1.07	1.33

0.80	1.11	0.82	0.82	0.82	0.84	0.23	1.78
1.11	1.12	1.14	1.11	1.11	1.07	0.81	0.83
0.84	0.83	0.82	1.04	0.80	2.85	4.47	5.95
1.47	1.04	1.37	0.78	1.06	7.07	2.13	1.40
1.43	0.97	0.82	0.84	0.84	0.84	0.89	1.08
0.87	0.89	0.66	0.66	0.67	0.68	0.71	0.68
6.79	8.00	2.55	1.27	1.23	0.74	0.76	0.64
0.66	0.66	1.61	3.23	3.88	1.05	1.58	1.24
1.53	5.17	1.16	2.63	0.57	0.84	0.66	0.70
0.63	0.64	0.94	0.64	33.30	200.06	115.70	8.31
11.13	18.66	14.38	8.45	3.83	1.80	1.30	0.93
0.75	0.56	0.35	0.83	0.85			

INFLOW QUANTITY FROM INFLOW POINT - 2 1992 CFS

585.60	526.00	511.20	532.40	486.70	433.30	407.80	371.60
369.20	364.90	369.30	355.50	336.70	328.00	308.40	299.10
303.60	305.30	288.20	282.00	265.40	249.50	242.70	247.00
250.30	305.10	276.90	262.20	244.60	234.90	225.80	210.20
203.20	204.50	193.50	183.20	179.10	175.90	168.80	171.10
160.70	159.50	151.40	550.70	1546.00	1684.00	1899.00	1207.00
872.40	1122.00	1322.00	2025.00	1429.00	1131.00	973.00	817.80
693.60	603.10	529.90	1043.00	775.60	640.30	537.40	493.90
456.70	432.00	399.00	390.50	397.40	424.70	388.00	372.20
365.80	348.70	350.80	332.70	324.10	306.90	292.00	289.80
288.90	278.60	275.60	273.30	266.40	264.20	274.20	252.40
271.90	286.90	270.90	291.40	296.40	274.30	272.40	267.50
251.50	245.70	245.90	332.00	625.10	503.80	596.10	575.20
441.40	376.10	355.80	337.80	327.50	321.50	322.60	365.60
415.90	412.30	416.00	399.80	397.20	398.90	391.40	393.80
398.30	400.00	404.70	394.20	401.10	417.50	439.60	417.10
373.20	364.20	375.20	376.20	395.50	410.40	414.50	416.70
444.70	441.10	421.40	413.50	469.50	484.60	481.20	513.90
567.30	528.20	454.10	415.30	390.90	377.90	367.20	357.00
341.40	327.40	333.40	309.30	284.00	274.10	270.60	266.10
274.30	288.10	280.80	279.30	280.90	282.20	285.20	277.70
288.60	381.90	348.90	283.20	247.00	227.70	214.40	203.80
243.70	240.70	233.00	251.10	216.10	187.60	177.50	164.70
151.70	146.10	135.70	129.10	125.80	119.00	116.50	114.50
106.50	100.80	100.80	91.07	87.51	87.29	84.43	80.48
78.58	74.08	74.39	70.29	72.25	67.25	69.63	64.22
67.76	62.89	63.52	62.14	56.31	60.57	60.39	59.26
56.02	56.35	56.38	50.20	48.04	46.05	49.50	47.41
45.67	46.39	45.72	42.93	42.23	39.72	40.20	42.20
39.56	40.94	38.06	38.25	34.91	33.45	33.74	34.03
41.55	30.84	37.80	36.68	34.15	37.19	32.46	34.34
34.09	31.54	32.56	31.29	32.98	32.67	32.85	36.17
32.64	30.27	37.23	34.83	50.51	50.65	43.21	43.47
40.46	41.05	50.82	45.03	42.44	58.29	45.20	48.60
51.40	44.81	43.65	42.73	44.66	43.30	58.46	57.75
50.01	46.45	43.36	42.86	39.42	41.67	42.00	38.77
37.70	40.17	42.07	43.68	41.61	57.52	87.32	127.40
60.65	62.55	73.89	54.35	51.81	217.10	160.70	104.80
85.68	73.36	66.46	62.17	60.86	58.39	49.48	54.89
52.67	50.21	51.44	52.71	48.30	42.87	40.87	44.48
145.00	286.30	164.40	114.20	93.06	84.18	78.69	71.38

67.75	68.40	76.82	144.90	208.80	160.40	128.50	115.70
160.80	293.20	272.10	289.40	190.40	154.60	138.80	129.20
119.10	120.80	112.90	119.70	648.60	2123.00	1290.00	583.00
446.50	500.10	794.10	556.70	386.90	315.40	280.80	270.80
244.40	223.50	207.90	191.40	177.70			

TEMPERATURE INFLOW FOR INFLOW POINT - 2 CELSIUS

3.70	3.40	3.60	4.30	3.90	2.80	2.60	3.80
4.20	4.40	4.40	4.10	3.70	4.00	4.10	4.70
5.10	4.40	3.70	3.90	3.70	3.70	4.90	5.10
5.20	4.60	4.00	4.40	3.60	3.80	3.50	3.20
3.60	3.90	3.00	1.90	2.40	3.10	2.70	3.40
2.70	2.70	3.50	5.00	5.70	6.20	6.40	6.10
6.30	7.00	7.40	5.90	4.50	4.10	4.00	5.00
5.40	5.60	5.90	6.00	5.60	5.60	5.60	4.90
5.10	5.50	6.40	7.00	7.00	6.30	4.90	5.90
5.80	4.60	4.40	4.00	4.70	4.90	4.70	4.60
5.00	5.40	5.90	6.10	5.90	5.70	4.50	4.10
3.20	3.50	3.80	4.00	4.20	4.50	4.20	4.20
4.70	4.90	5.20	5.70	5.80	5.80	6.00	5.30
4.60	5.20	6.10	6.10	5.90	6.50	7.00	7.40
7.40	7.10	7.00	6.80	7.20	7.30	6.60	7.60
7.50	7.50	7.80	7.10	7.60	8.20	8.10	6.30
5.90	6.90	7.30	8.00	8.40	8.50	8.20	8.60
7.80	7.30	7.90	9.10	9.80	9.20	9.20	9.90
10.40	8.60	7.50	7.60	8.30	8.90	8.70	9.30
8.30	7.30	7.20	7.10	8.60	9.20	9.30	10.40
11.60	11.10	10.90	10.50	11.20	12.40	13.00	13.20
13.60	12.80	12.80	13.40	13.40	13.30	13.40	12.90
12.90	12.90	11.80	11.50	12.20	12.40	11.90	11.30
11.00	12.00	13.00	12.80	13.00	13.40	14.20	15.10
15.10	14.80	14.90	13.60	13.20	14.60	15.60	16.10
16.10	15.60	15.40	15.40	16.00	16.50	17.00	17.00
17.40	17.80	18.20	17.50	16.00	14.40	13.70	14.90
15.30	16.00	16.00	17.20	16.80	15.70	15.60	14.80
15.30	15.20	15.30	14.80	15.10	15.50	16.50	16.50
16.50	16.90	17.20	16.80	16.60	15.70	14.80	14.30
15.10	14.60	14.50	15.00	15.40	15.20	13.90	14.00
14.30	14.10	14.80	14.80	13.50	12.00	13.60	13.00
11.90	10.80	11.30	11.80	11.50	11.50	10.90	11.10
11.60	11.90	13.20	12.20	10.70	10.80	11.10	10.10
8.80	8.80	9.30	11.00	10.60	9.10	9.10	8.30
8.50	8.40	8.50	8.80	9.10	9.10	9.60	9.80
9.60	9.40	7.40	7.10	8.60	10.00	10.30	9.90
9.10	9.60	8.20	6.70	6.40	7.80	8.00	6.60
6.30	4.80	5.50	6.80	6.20	6.90	4.70	4.50
4.10	2.90	2.50	3.30	2.70	1.90	1.70	3.00
5.40	5.10	4.20	4.20	4.50	4.00	4.40	3.00
3.30	4.10	5.60	5.60	5.00	4.10	3.90	4.30
5.30	5.50	5.80	4.60	3.40	2.10	2.20	2.50
2.60	3.50	3.60	4.10	4.80	5.60	5.10	4.90
5.20	5.00	5.30	4.20	4.00	3.40	3.60	4.30
3.50	2.40	1.90	2.00	2.10			

QUALITY FOR INFLOW POINT-2 SUSPENDED SOLIDS MG/L

1.55	1.46	0.15	0.73	0.15	0.16	0.16	0.17

0.17	0.17	0.17	0.17	0.17	0.18	0.18	0.18
0.18	0.18	0.37	0.19	0.19	0.19	0.20	0.20
0.19	0.54	0.56	0.19	0.20	0.20	0.20	0.21
0.21	0.21	0.21	0.22	0.22	0.22	0.23	0.22
0.23	0.23	0.24	2.73	46.48	10.54	31.75	2.88
9.06	6.92	2.27	13.16	3.51	7.23	1.28	0.37
0.26	0.28	0.15	0.79	0.51	0.27	0.29	0.15
0.15	0.16	0.16	0.16	0.16	0.48	0.33	0.17
0.34	0.34	0.51	0.17	0.35	0.18	0.18	0.18
0.18	0.19	0.19	0.19	0.19	0.19	1.50	0.19
0.19	0.55	0.19	0.37	0.00	0.38	0.19	0.19
0.19	0.20	0.20	0.35	2.61	2.83	3.91	0.28
0.47	0.50	0.34	0.17	0.18	0.18	0.18	0.50
0.96	0.96	0.16	0.16	0.16	0.16	0.16	0.16
0.00	0.16	0.16	0.16	0.16	0.00	0.16	0.16
0.33	0.34	0.17	0.33	0.33	0.32	0.16	0.16
0.00	0.16	0.16	0.00	0.31	0.60	0.15	0.00
0.00	0.15	0.31	0.32	0.16	0.17	0.17	0.17
0.17	0.18	0.17	0.90	0.19	0.19	0.19	0.19
0.19	0.18	0.37	0.19	0.00	0.19	0.18	0.19
0.18	0.33	0.34	2.96	0.20	0.20	0.21	2.52
0.20	0.59	0.20	0.19	0.21	0.22	0.22	0.23
0.23	0.24	0.24	0.25	0.25	0.26	0.26	0.26
0.27	0.27	0.27	0.29	0.29	0.29	0.29	0.30
0.30	0.31	0.31	0.31	0.31	0.32	0.32	0.33
0.32	0.33	0.33	0.33	0.34	0.33	0.33	0.34
0.34	0.34	0.34	0.36	0.36	0.37	0.36	0.37
0.37	0.37	0.37	0.38	0.38	0.39	0.39	0.38
0.39	0.39	0.40	0.40	0.41	0.42	0.42	0.41
0.38	0.43	0.40	0.40	0.41	0.40	0.42	0.41
0.41	0.43	0.42	0.43	0.42	0.42	0.42	0.40
0.42	0.43	0.40	0.41	0.36	0.36	0.38	0.38
0.39	0.39	0.36	0.37	0.38	0.34	0.37	0.36
0.35	0.37	0.38	0.38	0.37	0.38	0.34	0.34
0.36	0.37	0.38	0.38	0.39	0.38	0.38	0.39
0.40	0.39	0.38	0.38	0.38	0.68	0.58	0.75
0.33	0.33	0.31	0.35	0.35	2.05	2.30	0.81
0.58	0.31	0.32	0.33	0.33	0.67	0.36	0.35
0.35	0.36	0.35	0.35	0.36	0.38	0.39	0.37
0.96	2.58	2.51	0.78	0.28	0.29	0.30	0.31
0.32	0.32	0.61	0.72	2.08	0.92	1.50	0.78
0.46	4.02	0.94	0.18	0.86	1.17	0.49	0.25
0.26	0.26	0.53	0.26	2.03	26.21	24.37	7.60
2.96	6.72	0.50	0.43	2.47	0.53	0.37	0.19
0.20	0.20	0.21	0.21	0.22			

OUTFLOW QUANTITY CFS

1830.00	1830.00	1800.00	1360.00	1240.00	1120.00	1000.00	945.00
833.00	823.00	817.00	803.00	796.00	751.00	725.00	687.00
655.00	701.00	715.00	681.00	657.00	610.00	575.00	561.00
580.00	583.00	784.00	706.00	644.00	559.00	490.00	390.00
274.00	238.00	237.00	201.00	167.00	170.00	172.00	168.00
163.00	165.00	167.00	140.00	107.00	454.00	2220.00	2800.00
2810.00	3090.00	4280.00	3840.00	4250.00	3230.00	1840.00	658.00
598.00	896.00	1090.00	1810.00	2160.00	678.00	644.00	775.00

778.00	781.00	783.00	659.00	566.00	576.00	633.00	680.00
698.00	699.00	698.00	594.00	514.00	515.00	516.00	517.00
511.00	453.00	416.00	386.00	372.00	346.00	330.00	330.00
331.00	359.00	411.00	437.00	378.00	326.00	326.00	371.00
395.00	396.00	398.00	401.00	421.00	1540.00	1690.00	1780.00
1960.00	1520.00	1150.00	899.00	821.00	780.00	739.00	713.00
792.00	1170.00	1350.00	1230.00	1100.00	1000.00	1030.00	1050.00
1120.00	1260.00	1240.00	1140.00	970.00	1170.00	1250.00	1360.00
1320.00	1090.00	972.00	922.00	965.00	1000.00	1080.00	1120.00
1060.00	1170.00	1180.00	1040.00	962.00	1170.00	1310.00	1230.00
1250.00	1420.00	1400.00	1050.00	924.00	832.00	796.00	780.00
762.00	708.00	690.00	689.00	635.00	563.00	531.00	531.00
580.00	480.00	588.00	636.00	591.00	546.00	546.00	546.00
547.00	531.00	638.00	799.00	545.00	461.00	414.00	383.00
373.00	364.00	545.00	399.00	590.00	447.00	355.00	342.00
315.00	274.00	255.00	245.00	239.00	240.00	242.00	242.00
242.00	242.00	241.00	244.00	244.00	242.00	242.00	242.00
243.00	255.00	260.00	266.00	264.00	267.00	267.00	267.00
267.00	267.00	267.00	267.00	265.00	254.00	250.00	248.00
238.00	241.00	242.00	242.00	240.00	236.00	236.00	236.00
236.00	239.00	239.00	239.00	238.00	236.00	236.00	236.00
235.00	234.00	235.00	235.00	243.00	245.00	234.00	234.00
234.00	234.00	237.00	240.00	242.00	242.00	242.00	242.00
240.00	239.00	239.00	239.00	237.00	236.00	236.00	236.00
236.00	236.00	236.00	235.00	264.00	292.00	292.00	292.00
371.00	408.00	447.00	463.00	463.00	462.00	460.00	459.00
458.00	456.00	455.00	455.00	459.00	462.00	459.00	458.00
484.00	503.00	501.00	503.00	507.00	505.00	505.00	502.00
498.00	498.00	495.00	499.00	489.00	487.00	496.00	503.00
502.00	504.00	504.00	502.00	509.00	508.00	508.00	551.00
584.00	582.00	578.00	584.00	588.00	583.00	585.00	592.00
588.00	583.00	579.00	576.00	575.00	579.00	579.00	575.00
508.00	397.00	498.00	624.00	354.00	347.00	346.00	291.00
225.00	225.00	225.00	225.00	348.00	652.00	577.00	408.00
311.00	420.00	770.00	827.00	835.00	836.00	830.00	755.00
584.00	357.00	330.00	333.00	302.00	1060.00	2120.00	1540.00
1800.00	1790.00	1770.00	2000.00	2250.00	2210.00	1930.00	1770.00
1110.00	603.00	554.00	468.00	469.00			

STOP

APPENDIX C: EXAMPLE INPUT FILE II: PREDICTION MODE

EXAMPLE INPUT FILE II: PREDICTION MODE

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ANONYMOUS RESERVOIR EXAMPLE INPUT DATA
FILES          5    6
NOPRINT INPUT
PLOT       RELEASE   PROFILES
PREDICTION
QUALITIES      1
INFLOWS        2
LAYERS        60
THICKNESS          4.0
BOTTOM          1776.
VOLUME                                                      KACF       INCREMENT
  0.114     0.056     0.056     0.101     0.116     0.135     0.192     0.192
  0.279     0.308     0.337     0.424     0.424     0.526     0.560     0.595
  0.700     0.700     0.808     0.844     0.883     1.000     1.000     1.150
  1.200     1.240     1.360     1.360     1.540     1.600     1.640     1.760
  1.760     1.940     2.000     2.070     2.280     2.280     2.460     2.520
  2.600     2.840     2.840     3.020     3.080     3.150     3.360     3.360
  3.510     3.560     3.632     3.850     4.000     4.200     4.400     4.600
  4.800     5.000     5.200     5.400
WIDTH
   1.0       1.0       1.0       1.0       1.0       1.0       1.0       1.0
   1.0       1.0       1.0       1.0       1.0       1.0       1.0       1.0
   1.0       1.0       1.0       1.0       1.0       1.0       1.0       1.0
   1.0       1.0       1.0       1.0       1.0       1.0       1.0       1.0
   1.0       1.0       1.0       1.0       1.0       1.0       1.0       1.0
   1.0       1.0       1.0       1.0       1.0       1.0       1.0       1.0
   1.0       1.0       1.0       1.0       1.0       1.0       1.0       1.0
   1.0       1.0       1.0       1.0
PORTS          5
AREAS            30.0      30.0      30.0      50.0      50.0
ANGLE            3.14      3.14      3.14      3.14      3.14
HEIGHT           65.0     122.0     157.0     177.7     189.0
MINIMUM           1.0       1.0       1.0       1.0       1.0
MAXIMUM         300.0     300.0     300.0     500.0     500.0
WETWELL             1         2         1         2         1
SELMAX         1000.0    1000.0    1000.0    1000.0    1000.0
FLOODGATE        57.0       3.0       0.0    4500.0      3.14
HEAT             0.20      0.20
MIXING            20.    0.5E10
ENTRAIN          0.30
DENC        .00000062
SETV             0.00
INTERVAL       1  365
SIMULATE       1  365
PRINT DAYS   118  153  202  253  293
TARGET TEMPERATURES FOR THE RELEASE                   CELSIUS    SINCURVE
   6.0      .0174    -1.934      8.0
DEPTH           125.8
 TEMPERATURE - INITIAL                                  CELSIUS
   5.6       5.6       5.6       5.6       5.6       5.6       5.6       5.6
   5.6       5.6       5.6       5.6       5.6       5.6       5.6       5.6
   5.6       5.6       5.6       5.6       5.6       5.6       5.6       5.6
```

5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0				

QUALITY - INITIAL SUSPENDED SOLIDS MG/L

30.3	30.3	30.3	30.3	30.3	30.3	30.3	30.3
30.3	30.3	30.3	30.3	30.3	30.3	30.3	30.3
30.3	30.3	30.3	30.3	30.3	30.3	30.3	30.3
30.3	30.3	30.3	30.3	30.3	30.3	30.3	30.3
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0				

EQUILIBRIUM TEMPERATURE F-DEGREES 1992 FAHR

29.5	30.8	33.5	33.6	25.6	26.2	26.5	30.6
24.8	26.3	26.2	28.4	27.3	25.4	26.6	28.8
37.7	34.4	28.9	32.5	31.7	29.9	35.4	38.8
40.4	39.4	33.2	39.6	33.3	32.8	30.8	30.0
35.6	37.6	33.4	35.5	30.7	39.0	35.6	39.3
39.6	35.9	32.6	44.6	48.7	48.9	50.1	50.6
43.4	53.7	53.9	43.8	42.2	46.4	47.4	42.4
40.4	47.2	43.4	48.8	45.7	45.9	49.1	49.7
48.8	43.2	52.7	53.3	49.8	46.0	51.2	45.1
44.2	44.3	40.4	48.3	44.2	46.3	48.6	58.0
61.0	63.1	61.6	56.1	48.5	45.5	43.1	41.2
40.6	47.6	42.1	45.1	40.9	47.7	43.1	44.0
48.9	57.3	63.0	52.1	53.3	48.7	50.1	47.3
59.1	63.2	60.3	56.5	58.5	57.7	68.1	71.2
66.0	67.8	55.5	64.8	57.5	59.8	68.2	56.4
58.8	62.6	64.3	69.5	72.0	67.9	64.5	53.9
57.5	66.2	66.6	68.2	66.4	69.9	70.1	66.2
59.2	64.6	74.0	70.8	74.0	72.7	72.3	85.3
73.6	64.8	65.9	71.0	72.2	74.2	58.5	68.9
63.2	61.3	55.3	62.9	69.7	71.7	81.3	79.5
78.9	68.1	62.9	70.0	79.0	83.2	80.2	84.1
81.8	74.6	74.9	78.8	79.8	82.8	68.7	69.1
67.5	68.8	63.7	70.5	70.4	74.1	63.5	71.6
63.3	76.3	76.5	63.3	79.7	74.1	82.3	80.9
81.0	75.5	76.9	74.4	78.6	77.5	80.7	81.3
78.6	76.0	76.9	77.9	80.1	81.2	85.0	81.6
79.8	79.9	76.3	73.4	69.5	68.3	65.7	75.3
79.9	82.1	76.9	81.8	73.7	69.2	74.1	77.5
76.4	72.6	71.3	76.5	78.4	79.3	77.7	81.7
81.2	79.1	79.9	80.6	76.6	72.6	75.1	71.5
71.7	74.4	75.6	80.5	76.2	70.3	73.5	74.3
70.8	73.0	79.1	67.1	67.3	67.0	64.1	68.8
63.0	63.4	64.4	61.7	59.2	58.2	64.0	64.5
72.1	69.1	67.8	59.9	53.6	55.8	55.1	59.9
61.9	63.5	60.1	56.6	56.4	59.4	50.0	51.0
60.8	63.0	62.9	64.4	68.3	63.2	61.3	64.4
58.7	54.6	53.7	47.9	50.2	55.7	58.0	60.8
54.9	52.6	48.4	46.1	42.9	48.9	52.7	48.2
46.3	47.7	50.9	52.8	49.4	47.8	38.3	38.1

36.5	36.2	33.4	37.0	38.1	37.6	35.9	34.5
47.2	43.5	40.6	37.5	37.7	40.1	42.8	37.5
30.8	31.6	45.0	43.2	43.2	37.3	38.6	34.3
43.3	47.7	45.8	42.8	32.8	31.8	33.7	35.1
31.4	34.6	38.0	40.4	42.4	43.4	37.6	32.5
38.3	38.7	39.5	31.4	33.9	29.5	27.8	35.8
33.4	29.4	26.9	28.1	29.9			

EXCHANGE COEFFICIENTS BTU/DEG-F

55.8	72.4	66.1	66.1	31.0	45.5	28.7	29.6
29.1	31.4	29.4	39.8	39.4	31.2	31.4	29.8
42.5	50.3	31.7	40.5	48.3	40.0	33.4	31.9
44.4	79.8	40.8	42.8	40.5	40.5	[illegible]2.3	40.0
32.7	33.0	68.0	46.0	30.8	32.2	40.0	41.1
40.7	40.1	31.9	65.9	59.5	70.1	90.6	88.9
55.0	51.1	87.5	65.5	61.1	42.9	43.6	33.7
61.9	46.0	111.4	118.4	73.4	54.2	55.5	44.7
44.0	43.4	58.8	48.9	48.0	63.9	54.7	53.9
74.1	52.1	51.7	44.8	53.6	44.5	63.5	46.7
48.6	49.7	61.4	80.5	95.4	63.3	61.1	51.2
69.9	63.8	42.7	119.1	70.0	63.1	70.2	61.1
54.7	57.3	60.6	48.2	135.2	105.6	98.9	73.8
57.5	60.3	83.7	66.4	57.6	116.2	74.6	67.9
77.2	79.2	58.6	62.8	59.2	93.3	64.5	69.9
72.4	75.7	87.8	64.5	68.5	81.1	101.7	87.1
69.6	76.2	64.3	80.2	79.9	82.3	67.1	92.5
97.8	87.4	71.1	85.9	107.6	88.4	72.5	69.3
122.3	96.8	86.1	80.8	80.7	83.8	97.9	93.8
108.9	73.1	72.3	77.0	94.6	82.7	61.6	77.6
97.2	87.0	106.0	86.5	81.7	87.8	99.7	89.6
107.8	117.0	102.5	103.6	99.3	82.9	89.1	92.0
109.6	103.9	85.1	76.6	106.9	92.3	93.7	85.9
67.5	94.0	96.0	93.5	81.0	77.0	87.4	104.5
86.0	114.9	95.6	88.0	78.6	98.1	103.2	105.1
116.3	109.3	94.0	94.3	100.5	104.8	92.4	105.4
122.8	125.5	136.8	125.4	114.2	70.5	83.3	93.7
81.9	85.7	66.9	106.7	124.8	88.0	92.3	78.2
94.9	110.7	115.6	75.5	79.7	82.0	82.5	86.8
86.3	84.8	80.6	82.6	93.6	100.3	74.8	73.5
107.5	76.0	78.4	66.3	78.2	88.3	74.6	75.3
87.3	75.4	65.3	100.0	67.6	67.4	99.5	69.8
85.4	73.5	77.0	79.2	81.4	66.0	68.5	55.6
59.9	71.1	104.7	90.3	72.9	74.9	84.8	62.1
51.0	52.1	50.9	75.5	61.5	50.3	58.9	58.5
64.5	53.3	65.7	53.9	43.1	53.0	40.7	42.0
63.2	69.8	45.7	52.3	36.5	88.2	128.5	80.6
50.5	72.8	57.4	45.1	32.4	49.0	61.0	36.1
44.7	34.8	36.1	49.0	36.9	46.2	42.0	42.2
41.3	30.1	40.1	32.8	32.7	40.4	32.1	41.6
69.2	103.5	44.2	43.0	43.2	61.4	61.7	41.5
32.0	40.7	96.3	85.0	74.6	43.1	51.8	33.2
55.3	48.2	34.2	54.8	40.9	48.1	40.2	32.6
32.0	42.1	34.3	98.8	103.4	86.5	61.2	41.5
34.3	53.4	81.0	41.0	49.9	39.8	31.7	33.5
64.6	38.7	30.6	30.9	39.0			

SHORT WAVE RADIATION BTU/DEG-F

260.0	261.3	261.8	263.3	352.8	712.4	693.5	581.6
273.1	274.7	276.4	278.6	281.2	284.0	286.1	287.8
383.2	291.7	296.8	398.0	403.0	305.8	306.1	307.8
310.7	421.9	322.9	623.9	442.1	446.9	342.4	348.0
667.2	677.6	1007.9	1023.2	499.5	815.4	826.1	835.7
1089.7	766.3	403.7	400.0	400.9	407.1	415.1	914.5
427.8	569.7	575.9	443.7	879.7	1287.8	1275.2	784.7
476.6	644.2	487.5	950.5	830.2	681.3	992.3	1135.3
1024.7	532.0	716.2	535.8	541.0	747.9	1500.9	567.6
571.0	788.0	592.6	989.1	604.8	820.9	1349.7	1764.1
1777.9	1795.5	1807.5	1718.0	884.3	665.1	908.8	681.6
685.2	1150.5	699.6	1171.8	710.0	1195.9	977.9	987.4
991.7	1762.6	2109.7	741.6	1012.3	758.8	760.6	1044.3
1994.2	2223.9	2102.4	1748.8	1564.0	2296.1	2300.8	2294.0
1941.7	2300.2	824.7	1823.5	839.2	2008.0	2351.1	853.0
1153.6	1667.6	2385.9	2474.1	2412.0	1908.0	2345.0	1488.4
1491.2	2476.5	1970.2	2135.6	1750.7	2149.8	1998.5	1770.4
1522.4	2348.9	2593.3	2005.7	2562.3	2190.5	1803.3	2594.8
2607.8	2667.4	2635.1	2665.2	2552.0	2694.0	943.1	2425.3
2656.9	1600.1	949.2	1592.3	2695.0	2575.7	2671.8	2569.0
2542.9	943.4	1288.4	1855.6	2544.9	2676.7	2689.5	2672.3
2513.0	1261.9	1254.8	2052.1	2690.2	2711.0	941.3	934.0
923.4	1572.1	936.9	1269.6	1564.5	2068.6	1282.5	2269.8
943.4	2649.3	2389.3	939.3	2604.8	1559.0	2481.6	2609.6
2198.2	2182.7	2599.0	2640.1	2624.0	2176.3	2555.2	2558.5
2562.9	2555.0	2552.1	2548.7	2535.6	2373.5	2477.7	2474.5
2468.6	2445.6	2381.8	2321.5	2223.2	1455.5	1169.9	2292.4
2420.6	2397.9	834.9	2111.7	2337.9	1385.1	2104.0	2335.5
2308.5	1755.5	2281.9	2281.4	2265.3	2227.5	1523.7	2198.8
2184.5	1675.6	2169.6	2160.5	2106.2	2138.4	2089.0	1450.7
1955.8	2061.1	2050.0	1924.0	1566.7	1379.7	1984.7	1968.0
1762.7	1629.3	1916.9	1592.3	1864.5	1698.6	876.7	1847.5
1854.3	1732.9	1513.0	845.6	613.1	611.3	1321.5	996.2
1661.8	1557.4	1438.6	951.0	571.1	562.4	749.3	1559.7
1509.9	1489.7	1038.5	523.0	866.1	1221.7	509.0	679.7
1360.0	1367.8	1360.1	1343.4	1321.1	1100.1	619.2	986.9
980.8	1124.9	1123.8	599.4	433.5	419.9	413.5	1062.9
670.2	400.7	657.9	530.2	522.1	379.6	862.0	616.8
958.4	983.4	887.4	578.5	571.4	743.0	658.8	556.2
775.8	769.3	631.4	698.5	832.5	875.8	776.6	307.7
396.5	397.2	392.9	293.5	290.0	383.9	739.3	786.4
376.5	280.4	273.6	359.9	269.9	269.0	438.8	266.3
262.0	551.1	255.9	552.0	557.1	425.1	709.7	703.5
621.8	253.3	331.7	25[illegible].9	249.4	247.3	330.1	250.6
248.6	248.0	249.0	251.0	332.2	481.7	253.6	251.5
649.2	704.2	708.2	709.3	710.5			

WIND SPEED MPH

6.0	8.0	7.0	7.0	2.0	5.0	2.0	2.0
2.0	2.0	2.0	3.0	3.0	2.0	2.0	2.0
3.0	5.0	2.0	3.0	5.0	3.0	2.0	2.0
3.0	8.0	3.0	3.0	3.0	3.0	2.0	3.0
2.0	[illegible].0	8.0	5.0	2.0	2.0	3.0	3.0
3.0	3.0	2.0	6.0	5.0	6.0	8.0	8.0

5.0	3.0	7.0	6.0	6.0	3.0	3.0	2.0
6.0	3.0	12.0	12.0	7.0	5.0	5.0	3.0
3.0	3.0	5.0	3.0	3.0	6.0	5.0	5.0
7.0	5.0	5.0	3.0	5.0	3.0	6.0	3.0
3.0	3.0	5.0	7.0	9.0	6.0	6.0	5.0
7.0	6.0	3.0	13.0	7.0	6.0	7.0	6.0
5.0	5.0	5.0	3.0	13.0	10.0	9.0	7.0
5.0	5.0	7.0	6.0	5.0	12.0	6.0	5.0
6.0	6.0	5.0	5.0	5.0	8.0	5.0	6.0
6.0	6.0	7.0	5.0	5.0	6.0	8.0	8.0
6.0	6.0	5.0	6.0	6.0	6.0	5.0	7.0
8.0	7.0	5.0	6.0	7.0	6.0	5.0	3.0
8.0	8.0	7.0	6.0	6.0	6.0	8.0	7.0
9.0	6.0	6.0	6.0	7.0	6.0	3.0	5.0
6.0	6.0	8.0	6.0	5.0	5.0	6.0	5.0
6.0	7.0	6.0	6.0	6.0	5.0	6.0	6.0
7.0	7.0	6.0	5.0	7.0	6.0	7.0	6.0
5.0	6.0	6.0	7.0	5.0	5.0	5.0	6.0
5.0	7.0	6.0	6.0	5.0	6.0	6.0	6.0
7.0	7.0	6.0	6.0	6.0	6.0	5.0	6.0
7.0	7.0	8.0	8.0	8.0	5.0	6.0	6.0
5.0	5.0	3.0	6.0	8.0	6.0	6.0	5.0
6.0	7.0	8.0	5.0	5.0	5.0	5.0	5.0
5.0	5.0	5.0	5.0	6.0	7.0	5.0	5.0
7.0	5.0	5.0	3.0	5.0	6.0	5.0	5.0
6.0	5.0	3.0	7.0	5.0	5.0	7.0	5.0
7.0	6.0	6.0	6.0	6.0	5.0	5.0	3.0
3.0	5.0	7.0	7.0	6.0	6.0	7.0	5.0
3.0	3.0	3.0	6.0	5.0	3.0	5.0	5.0
5.0	3.0	5.0	3.0	2.0	3.0	2.0	2.0
5.0	6.0	3.0	5.0	2.0	7.0	10.0	6.0
3.0	6.0	5.0	3.0	2.0	3.0	5.0	2.0
3.0	2.0	2.0	3.0	2.0	3.0	3.0	3.0
3.0	2.0	3.0	2.0	2.0	3.0	2.0	3.0
6.0	10.0	3.0	3.0	3.0	6.0	6.0	3.0
2.0	3.0	9.0	8.0	7.0	3.0	5.0	2.0
5.0	3.0	2.0	5.0	3.0	5.0	3.0	2.0
2.0	3.0	2.0	10.0	10.0	8.0	6.0	3.0
2.0	5.0	8.0	3.0	5.0	3.0	2.0	2.0
7.0	3.0	2.0	2.0	3.0			

```
INFLOW QUANTITY  FROM INFLOW POINT - 1  1992    CFS       MONTH
 653.85   1227.73    550.37    723.92    690.57    275.52     86.28     34.36
  30.15     77.78    150.87    653.73
TEMPERATURE INFLOW  FOR INFLOW POINT - 1        CELSIUS   SINCURVE
   6.0    0.0174   -2.2340      9.75
QUALITY FOR INFLOW POINT - 1 SUSPENDED SOLIDS   MG/L      MONTH
   2.67     24.57      4.14      3.51      3.80      2.11      1.44      1.01
   1.08      1.57      1.55     14.20
INFLOW QUANTITY FROM INFLOW POINT - 2   1992    CFS       MONTH
 454.72    822.11    390.13    370.73    424.81    279.73    101.10     44.99
  39.50     62.68     88.64    373.74
```

```
TEMPERATURE INFLOW  FOR INFLOW POINT - 2          CELSIUS    SINCURVE
   6.0      0.0174   -2.2340      9.00
QUALITY FOR INFLOW POINT-2 SUSPENDED SOLIDS      MG/L       MONTH
   0.31       5.05       0.31       0.58       0.19       0.41       0.28       0.38
   0.39       0.53       0.64       2.82
OUTFLOW QUANTITY                                 CFS        MONTH
 866.48    1243.39     648.65     885.80    1121.71     566.37     267.68     239.58
 306.13     492.48     485.83    1029.65
STOP
```

APPENDIX D: EXAMPLE INPUT FILE II: VERIFICATION MODE

EXAMPLE INPUT FILE II: VERIFICATION MODE

```
ANONYMOUS RESERVOIR EXAMPLE INPUT DATA
FILES          5    6
NOPRINT INPUT
PLOT        RELEASE   PROFILES
VERIFICATION
QUALITIES      1
INFLOWS        2
LAYERS        60
THICKNESS          4.0
BOTTOM           1776.
VOLUME                                                       KACF      INCREMENT
  0.114     0.056     0.056     0.101     0.116     0.135     0.192     0.192
  0.279     0.308     0.337     0.424     0.424     0.526     0.560     0.595
  0.700     0.700     0.808     0.844     0.883     1.000     1.000     1.150
  1.200     1.240     1.360     1.360     1.540     1.600     1.640     1.760
  1.760     1.940     2.000     2.070     2.280     2.280     2.460     2.520
  2.600     2.840     2.840     3.020     3.080     3.150     3.360     3.360
  3.510     3.560     3.632     3.850     4.000     4.200     4.400     4.600
  4.800     5.000     5.200     5.400
WIDTH
     1.0       1.0       1.0       1.0       1.0       1.0       1.0       1.0
     1.0       1.0       1.0       1.0       1.0       1.0       1.0       1.0
     1.0       1.0       1.0       1.0       1.0       1.0       1.0       1.0
     1.0       1.0       1.0       1.0       1.0       1.0       1.0       1.0
     1.0       1.0       1.0       1.0       1.0       1.0       1.0       1.0
     1.0       1.0       1.0       1.0       1.0       1.0       1.0       1.0
     1.0       1.0       1.0       1.0       1.0       1.0       1.0       1.0
     1.0       1.0       1.0       1.0
PORTS          3
AREAS             30.0       30.0       57.0
ANGLE             3.14       3.14       3.14
HEIGHT           122.0      178.0        3.0
HEAT              0.20       0.20
MIXING             20.     0.5E10
ENTRAIN           0.30
DENC         .00000062
SETV              0.00
INTERVAL       1   365
SIMULATE       1   365
PRINT DAYS   118   153   202   253   293
DEPTH            125.8
TEMPERATURE - INITIAL                                      CELSIUS
     5.6       5.6       5.6       5.6       5.6       5.6       5.6       5.6
     5.6       5.6       5.6       5.6       5.6       5.6       5.6       5.6
     5.6       5.6       5.6       5.6       5.6       5.6       5.6       5.6
     5.6       5.6       5.6       5.6       5.6       5.6       5.6       5.6
     0.0       0.0       0.0       0.0       0.0       0.0       0.0       0.0
     0.0       0.0       0.0       0.0       0.0       0.0       0.0       0.0
     0.0       0.0       0.0       0.0       0.0       0.0       0.0       0.0
     0.0       0.0       0.0       0.0
```

QUALITY - INITIAL SUSPENDED SOLIDS MG/L

30.3	30.3	30.3	30.3	30.3	30.3	30.3	30.3
30.3	30.3	30.3	30.3	30.3	30.3	30.3	30.3
30.3	30.3	30.3	30.3	30.3	30.3	30.3	30.3
30.3	30.3	30.3	30.3	30.3	30.3	30.3	30.3
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0				

EQUILIBRIUM TEMPERATURE F-DEGREES 1992 FAHR

29.5	30.8	33.5	33.6	25.6	26.2	26.5	30.6
24.8	26.3	26.2	28.4	27.3	25.4	26.6	28.8
37.7	34.4	28.9	32.5	31.7	29.9	35.4	38.8
40.4	39.4	33.2	39.6	33.3	32.8	30.8	30.0
35.6	37.6	33.4	35.5	30.7	39.0	35.6	39.3
39.6	35.9	32.6	44.6	48.7	48.9	50.1	50.6
43.4	53.7	53.9	43.8	42.2	46.4	47.4	42.4
40.4	47.2	43.4	48.8	45.7	45.9	49.1	49.7
48.8	43.2	52.7	53.3	49.8	46.0	51.2	45.1
44.2	44.3	40.4	48.3	44.2	46.3	48.6	58.0
61.0	63.1	61.6	56.1	48.5	45.5	43.1	41.2
40.6	47.6	42.1	45.1	40.9	47.7	43.1	44.0
48.9	57.3	63.0	52.1	53.3	48.7	50.1	47.3
59.1	63.2	60.3	56.5	58.5	57.7	68.1	71.2
66.0	67.8	55.5	64.8	57.5	59.8	68.2	56.4
58.8	62.6	64.3	69.5	72.0	67.9	64.5	53.9
57.5	66.2	66.6	68.2	66.4	69.9	70.1	66.2
59.2	64.6	74.0	70.8	74.0	72.7	72.3	85.3
73.6	64.8	65.9	71.0	72.2	74.2	58.5	68.9
63.2	61.3	55.3	62.9	69.7	71.7	81.3	79.5
78.9	68.1	62.9	70.0	79.0	83.2	80.2	84.1
81.8	74.6	74.9	78.8	79.8	82.8	68.7	69.1
67.5	68.8	63.7	70.5	70.4	74.1	63.5	71.6
63.3	76.3	76.5	63.3	79.7	74.1	82.3	80.9
81.0	75.5	76.9	74.4	78.6	77.5	80.7	81.3
78.6	76.0	76.9	77.9	80.1	81.2	85.0	81.6
79.8	79.9	76.3	73.4	69.5	68.3	65.7	75.3
79.9	82.1	76.9	81.8	73.7	69.2	74.1	77.5
76.4	72.6	71.3	76.5	78.4	79.3	77.7	81.7
81.2	79.1	79.9	80.6	76.6	72.6	75.1	71.5
71.7	74.4	75.6	80.5	76.2	70.3	73.5	74.3
70.8	73.0	79.1	67.1	67.3	67.0	64.1	68.8
63.0	63.4	64.4	61.7	59.2	58.2	64.0	64.5
72.1	69.1	67.8	59.9	53.6	55.8	55.1	59.9
61.9	63.5	60.1	56.6	56.4	59.4	50.0	51.0
60.8	63.0	62.9	64.4	68.3	63.2	61.3	64.4
58.7	54.6	53.7	47.9	50.2	55.7	58.0	60.8
54.9	52.6	48.4	46.1	42.9	48.9	52.7	48.2
46.3	47.7	50.9	52.8	49.4	47.8	38.3	38.1
36.5	36.2	33.4	37.0	38.1	37.6	35.9	34.5
47.2	43.5	40.6	37.5	37.7	40.1	42.8	37.5
30.8	31.6	45.0	43.2	43.2	37.3	38.6	34.3
43.3	47.7	45.8	42.8	32.8	31.8	33.7	35.1
31.4	34.6	38.0	40.4	42.4	43.4	37.6	32.5

38.3	38.7	39.5	31.4	33.9	29.5	27.8	35.8
33.4	29.4	26.9	28.1	29.9			

EXCHANGE COEFFICIENTS BTU/DEG-F

55.8	72.4	66.1	66.1	31.0	45.5	28.7	29.6
29.1	31.4	29.4	39.8	39.4	31.2	31.4	29.8
42.5	50.3	31.7	40.5	48.3	40.0	33.4	31.9
44.4	79.8	40.8	42.8	40.5	40.5	32.3	40.0
32.7	33.0	68.0	46.0	30.8	32.2	40.0	41.1
40.7	40.1	31.9	65.9	59.5	70.1	90.6	88.9
55.0	51.1	87.5	65.5	61.1	42.9	43.6	33.7
61.9	46.0	111.4	118.4	73.4	54.2	55.5	44.7
44.0	43.4	58.8	48.9	48.0	63.9	54.7	53.9
74.1	52.1	51.7	44.8	53.6	44.5	63.5	46.7
48.6	49.7	61.4	80.5	95.4	63.3	61.1	51.2
69.9	63.8	42.7	119.1	70.0	63.1	70.2	61.1
54.7	57.3	60.6	48.2	135.2	105.6	98.9	73.8
57.5	60.3	83.7	66.4	57.6	116.2	74.6	67.9
77.2	79.2	58.6	62.8	59.2	93.3	64.5	69.9
72.4	75.7	87.8	64.5	68.5	81.1	101.7	87.1
69.6	76.2	64.3	80.2	79.9	82.3	67.1	92.5
97.8	87.4	71.1	85.9	107.6	88.4	72.5	69.3
122.3	96.8	86.1	80.8	80.7	83.8	97.9	93.8
108.9	73.1	72.3	77.0	94.6	82.7	61.6	77.6
97.2	87.0	106.0	86.5	81.7	87.8	99.7	89.6
107.8	117.0	102.5	103.6	99.3	82.9	89.1	92.0
109.6	103.9	85.1	76.6	106.9	92.3	93.7	85.9
67.5	94.0	96.0	93.5	81.0	77.0	87.4	104.5
86.0	114.9	95.6	88.0	78.6	98.1	103.2	105.1
116.3	109.3	94.0	94.3	100.5	104.8	92.4	105.4
122.8	125.5	136.8	125.4	114.2	70.5	83.3	93.7
81.9	85.7	66.9	106.7	124.8	88.0	92.3	78.2
94.9	110.7	115.6	75.5	79.7	82.0	82.5	86.8
86.3	84.8	80.6	82.6	93.6	100.3	74.8	73.5
107.5	76.0	78.4	66.3	78.2	88.3	74.6	75.3
87.3	75.4	65.3	100.0	67.6	67.4	99.5	69.8
85.4	73.5	77.0	79.2	81.4	66.0	68.5	55.6
59.9	71.1	104.7	90.3	72.9	74.9	84.8	62.1
51.0	52.1	50.9	75.5	61.5	50.3	58.9	58.5
64.5	53.3	65.7	53.9	43.1	53.0	40.7	42.0
63.2	69.8	45.7	52.3	36.5	88.2	128.5	80.6
50.5	72.8	57.4	45.1	32.4	49.0	61.0	36.1
44.7	34.8	36.1	49.0	36.9	46.2	42.0	42.2
41.3	30.1	40.1	32.8	32.7	40.4	32.1	41.6
69.2	103.5	44.2	43.0	43.2	61.4	61.7	41.5
32.0	40.7	96.3	85.0	74.6	43.1	51.8	33.2
55.3	48.2	34.2	54.8	40.9	48.1	40.2	32.6
32.0	42.1	34.3	98.8	103.4	86.5	61.2	41.5
34.3	53.4	81.0	41.0	49.9	39.8	31.7	33.5
64.6	38.7	30.6	30.9	39.0			

SHORT WAVE RADIATION BTU/DEG-F

260.0	261.3	261.8	263.3	352.8	712.4	693.5	581.6
273.1	274.7	276.4	278.6	281.2	284.0	286.1	287.8
383.2	291.7	296.8	398.0	403.0	305.8	306.1	307.8
310.7	421.9	322.9	623.9	442.1	446.9	342.4	348.0

667.2	677.6	1007.9	1023.2	499.5	815.4	826.1	835.7
1089.7	766.3	403.7	400.0	400.9	407.1	415.1	914.5
427.8	569.7	575.9	443.7	879.7	1287.8	1275.2	784.7
476.6	644.2	487.5	950.5	830.2	681.3	992.3	1135.3
1024.7	532.0	716.2	535.8	541.0	747.9	1500.9	567.6
571.0	788.0	592.6	989.1	604.8	820.9	1349.7	1764.1
1777.9	1795.5	1807.5	1718.0	884.3	665.1	908.8	681.6
685.2	1150.5	699.6	1171.8	710.0	1195.9	977.9	987.4
991.7	1762.6	2109.7	741.6	1012.3	758.8	760.6	1044.3
1994.2	2223.9	2102.4	1748.8	1564.0	2296.1	2300.8	2294.0
1941.7	2300.2	824.7	1823.5	839.2	2008.0	2351.1	853.0
1153.6	1667.6	2385.9	2474.1	2412.0	1908.0	2345.0	1488.4
1491.2	2476.5	1970.2	2135.6	1750.7	2149.8	1998.5	1770.4
1522.4	2348.9	2593.3	2005.7	2562.3	2190.5	1803.3	2594.8
2607.8	2667.4	2635.1	2665.2	2552.0	2694.0	943.1	2425.3
2656.9	1600.1	949.2	1592.3	2695.0	2575.7	2671.8	2569.0
2542.9	943.4	1288.4	1855.6	2544.9	2676.7	2689.5	2672.3
2513.0	1261.9	1254.8	2052.1	2690.2	2711.0	941.3	934.0
923.4	1572.1	936.9	1269.6	1564.5	2068.6	1282.5	2269.8
943.4	2649.3	2389.3	939.3	2604.8	1559.0	2481.6	2609.6
2198.2	2182.7	2599.0	2640.1	2624.0	2176.3	2555.2	2558.5
2562.9	2555.0	2552.1	2548.7	2535.6	2373.5	2477.7	2474.5
2468.6	2445.6	2381.8	2321.5	2223.2	1455.5	1169.9	2292.4
2420.6	2397.9	834.9	2111.7	2337.9	1385.1	2104.0	2335.5
2308.5	1755.5	2281.9	2281.4	2265.3	2227.5	1523.7	2198.8
2184.5	1675.6	2169.6	2160.5	2106.2	2138.4	2089.0	1450.7
1955.8	2061.1	2050.0	1924.0	1566.7	1379.7	1984.7	1968.0
1762.7	1629.3	1916.9	1592.3	1864.5	1698.6	876.7	1847.5
1854.3	1732.9	1513.0	845.6	613.1	611.3	1321.5	996.2
1661.8	1557.4	1438.6	951.0	571.1	562.4	749.3	1559.7
1509.9	1489.7	1038.5	523.0	866.1	1221.7	509.0	679.7
1360.0	1367.8	1360.1	1343.4	1321.1	1100.1	619.2	986.9
980.8	1124.9	1123.8	599.4	433.5	419.9	413.5	1062.9
670.2	400.7	657.9	530.2	522.1	379.6	862.0	616.8
958.4	983.4	887.4	578.5	571.4	743.0	658.8	556.2
775.8	769.3	631.4	698.5	832.5	875.8	776.6	307.7
396.5	397.2	392.9	293.5	290.0	383.9	739.3	786.4
376.5	280.4	273.6	359.9	269.9	269.0	438.8	266.3
262.0	551.1	255.9	552.0	557.1	425.1	709.7	703.5
621.8	253.3	331.7	251.9	249.4	247.3	330.1	250.6
248.6	248.0	249.0	251.0	332.2	481.7	253.6	251.5
649.2	704.2	708.2	709.3	710.5			

WIND SPEED MPH

6.0	8.0	7.0	7.0	2.0	5.0	2.0	2.0
2.0	2.0	2.0	3.0	3.0	2.0	2.0	2.0
3.0	5.0	2.0	3.0	5.0	3.0	2.0	2.0
3.0	8.0	3.0	3.0	3.0	3.0	2.0	3.0
2.0	2.0	8.0	5.0	2.0	2.0	3.0	3.0
3.0	3.0	2.0	6.0	5.0	6.0	8.0	8.0
5.0	3.0	7.0	6.0	6.0	3.0	3.0	2.0
6.0	3.0	12.0	12.0	7.0	5.0	5.0	3.0
3.0	3.0	5.0	3.0	3.0	6.0	5.0	5.0
7.0	5.0	5.0	3.0	5.0	3.0	6.0	3.0
3.0	3.0	5.0	7.0	9.0	6.0	6.0	5.0

7.0	6.0	3.0	13.0	7.0	6.0	7.0	6.0
5.0	5.0	5.0	3.0	13.0	10.0	9.0	7.0
5.0	5.0	7.0	6.0	5.0	12.0	6.0	5.0
6.0	6.0	5.0	5.0	5.0	8.0	5.0	6.0
6.0	6.0	7.0	5.0	5.0	6.0	8.0	8.0
6.0	6.0	5.0	6.0	6.0	6.0	5.0	7.0
8.0	7.0	5.0	6.0	7.0	6.0	5.0	3.0
8.0	8.0	7.0	6.0	6.0	6.0	8.0	7.0
9.0	6.0	6.0	5.0	7.0	6.0	3.0	5.0
6.0	6.0	8.0	6.0	5.0	5.0	6.0	5.0
6.0	7.0	6.0	6.0	6.0	5.0	6.0	6.0
7.0	7.0	6.0	5.0	7.0	6.0	7.0	6.0
5.0	6.0	6.0	7.0	5.0	5.0	5.0	6.0
5.0	7.0	6.0	6.0	5.0	6.0	6.0	6.0
7.0	7.0	6.0	6.0	6.0	6.0	5.0	6.0
7.0	7.0	8.0	8.0	8.0	5.0	6.0	6.0
5.0	5.0	3.0	6.0	8.0	6.0	6.0	5.0
6.0	7.0	8.0	5.0	5.0	5.0	5.0	5.0
5.0	5.0	5.0	5.0	6.0	7.0	5.0	5.0
7.0	5.0	5.0	3.0	5.0	6.0	5.0	5.0
6.0	5.0	3.0	7.0	5.0	5.0	7.0	5.0
7.0	6.0	6.0	6.0	6.0	5.0	5.0	3.0
3.0	5.0	7.0	7.0	6.0	6.0	7.0	5.0
3.0	3.0	3.0	6.0	5.0	3.0	5.0	5.0
5.0	3.0	5.0	3.0	2.0	3.0	2.0	2.0
5.0	6.0	3.0	5.0	2.0	7.0	10.0	6.0
3.0	6.0	5.0	3.0	2.0	3.0	5.0	2.0
3.0	2.0	2.0	3.0	2.0	3.0	3.0	3.0
3.0	2.0	3.0	2.0	2.0	3.0	2.0	3.0
6.0	10.0	3.0	3.0	3.0	6.0	6.0	3.0
2.0	3.0	9.0	8.0	7.0	3.0	5.0	2.0
5.0	3.0	2.0	5.0	3.0	5.0	3.0	2.0
2.0	3.0	2.0	10.0	10.0	8.0	6.0	3.0
2.0	5.0	8.0	3.0	5.0	3.0	2.0	2.0
7.0	3.0	2.0	2.0	3.0			

INFLOW QUANTITY FROM INFLOW POINT - 1 1992 CFS

858.40	732.00	700.80	711.70	629.30	561.20	526.10	475.90
455.80	439.00	437.20	427.90	414.30	406.10	384.10	372.50
393.90	407.70	381.60	367.40	346.60	325.50	323.90	331.10
345.70	465.90	429.00	400.50	366.80	352.40	335.10	311.90
299.50	291.20	276.70	256.60	251.10	243.20	232.60	232.40
214.53	209.20	196.30	670.30	3195.00	2795.00	3670.00	2397.00
1483.60	2200.40	2070.00	2682.00	1835.20	1379.20	1140.00	981.20
877.50	777.90	688.10	1192.00	1132.50	993.70	859.60	777.10
708.40	660.00	611.90	612.60	614.60	690.30	621.00	575.90
550.50	498.50	487.70	461.00	436.90	404.70	381.80	369.30
361.10	343.60	339.80	341.70	337.70	333.50	346.20	313.10
348.80	356.00	320.40	351.30	350.80	327.50	325.50	317.60
297.80	297.00	304.30	403.00	1163.90	1139.20	1400.80	1294.70
970.60	811.90	732.20	678.20	647.20	656.00	706.40	830.40
982.10	1020.70	984.00	934.30	876.70	887.10	860.70	845.30
861.70	835.00	834.30	813.80	778.90	832.50	920.40	848.80
706.80	617.90	566.50	579.30	624.60	669.50	660.50	663.30
715.30	679.90	608.60	607.50	745.40	771.40	743.80	780.10

842.70	747.70	570.90	488.40	446.10	428.30	417.80	400.00
381.10	357.60	355.60	311.00	284.00	276.60	280.10	279.50
299.90	314.40	285.70	276.80	275.20	278.90	275.40	259.30
252.50	370.00	326.00	242.00	208.98	186.30	173.60	159.11
205.03	239.90	220.50	279.40	211.16	177.05	164.49	150.30
137.44	128.62	119.36	114.92	109.25	102.79	100.78	97.80
91.08	85.22	83.73	73.73	70.29	71.02	68.88	65.11
63.02	58.83	59.51	57.11	57.65	54.55	56.68	51.98
54.54	50.31	49.68	49.06	44.90	46.23	44.91	45.64
42.80	43.47	44.42	39.55	37.19	35.65	36.75	34.82
35.02	34.79	35.47	33.74	32.43	30.90	30.92	32.46
30.06	30.70	28.54	28.28	25.04	25.08	25.30	25.52
31.61	24.14	28.76	28.34	26.83	28.34	25.51	26.16
26.42	24.45	24.42	24.70	21.50	23.34	23.15	24.87
24.86	22.70	28.85	26.99	35.77	40.18	31.98	33.08
32.75	32.84	37.57	33.77	34.36	43.71	37.67	40.83
38.55	35.07	35.71	35.60	36.16	34.02	47.64	47.55
35.00	33.54	32.08	35.07	34.49	37.28	36.47	34.69
32.74	33.83	35.43	37.93	36.99	54.78	109.69	125.54
74.25	75.95	124.11	85.55	71.49	526.40	299.90	136.28
95.02	78.04	68.84	65.54	65.34	67.81	58.01	63.72
62.42	58.90	59.67	61.49	58.80	55.12	50.60	56.12
184.45	597.00	357.30	221.07	174.71	146.32	137.20	124.43
113.85	115.30	139.58	300.44	503.30	385.80	277.45	248.24
452.30	894.80	875.90	832.50	515.00	378.80	306.10	267.25
226.73	220.22	201.43	214.08	853.40	2921.00	1999.90	1123.00
882.40	928.90	1105.90	930.30	671.10	526.60	450.00	416.20
365.70	328.40	305.90	283.20	262.80			

TEMPERATURE INFLOW FOR INFLOW POINT - 1 CELSIUS

4.65	3.80	3.70	4.20	4.10	3.20	2.70	3.75
4.20	4.40	4.40	4.25	3.75	3.95	4.05	4.65
5.10	4.10	3.65	4.05	3.70	3.75	4.85	5.05
5.15	4.50	4.15	4.55	3.90	4.05	3.95	3.52
3.77	4.09	3.48	3.44	3.72	3.23	3.21	3.98
4.00	4.00	3.30	3.68	4.01	5.76	5.44	5.61
5.86	5.31	5.65	5.67	5.25	4.38	4.73	4.75
5.00	5.35	5.35	5.50	5.20	5.20	5.35	5.00
5.05	5.30	6.20	6.80	6.60	6.00	4.90	5.60
5.75	4.65	4.40	4.25	4.70	4.85	4.60	4.70
5.15	5.55	6.05	6.40	6.35	5.90	4.50	4.20
3.00	3.00	3.65	3.65	3.50	4.25	4.05	3.95
4.80	5.05	5.40	5.55	5.35	5.60	5.80	5.45
5.20	5.70	6.30	6.25	6.10	6.55	6.80	7.05
6.90	6.70	6.65	6.50	6.90	6.95	6.50	7.20
6.85	7.05	7.20	6.75	7.15	7.50	7.35	6.10
5.90	6.70	7.05	7.75	7.90	7.95	7.65	8.00
7.30	7.10	7.60	8.60	9.00	8.45	8.55	9.05
9.40	8.15	7.50	7.90	8.60	8.95	8.75	9.15
8.45	7.70	7.45	7.60	8.80	9.45	9.55	10.60
11.60	11.15	10.75	11.00	11.40	12.45	13.00	13.40
13.75	13.40	13.15	13.95	13.90	14.00	14.10	13.80
13.60	13.40	12.35	11.95	12.50	12.70	12.40	12.00
11.60	12.65	13.65	13.25	13.60	13.95	14.50	15.55
15.65	15.65	15.75	14.65	14.15	15.35	16.40	16.80

16.85	16.50	16.30	16.15	16.75	17.25	17.75	17.85
18.20	18.50	19.00	18.45	17.00	15.50	14.85	15.95
16.25	17.00	16.90	18.15	17.85	16.75	16.75	16.05
16.25	16.35	16.45	15.85	16.05	16.45	17.25	17.35
17.35	17.80	18.00	17.65	17.55	16.70	16.59	15.71
15.93	15.81	15.80	15.95	16.25	16.05	14.90	14.90
15.15	15.05	15.65	15.35	14.30	13.00	14.40	13.95
12.95	11.85	12.00	12.40	12.20	12.35	11.60	11.85
12.50	12.85	14.05	13.20	11.50	11.50	11.75	10.90
9.80	9.70	10.00	11.45	10.85	9.80	9.65	8.95
9.30	9.25	9.35	9.55	9.70	9.80	10.10	10.30
10.20	10.05	8.40	7.95	9.05	10.10	10.40	10.30
9.80	10.15	8.50	7.40	6.75	7.75	8.10	6.70
6.50	5.30	5.75	6.80	6.55	6.95	5.25	4.95
4.75	3.45	3.00	3.35	2.95	2.30	2.10	3.05
5.35	5.00	3.80	4.25	4.50	4.35	4.50	3.50
3.60	4.10	5.40	5.40	5.15	4.45	4.35	4.55
5.45	5.50	5.80	5.00	3.90	3.05	3.05	3.20
3.25	4.05	4.25	4.40	4.55	5.35	4.95	4.95
5.20	4.59	4.93	4.46	4.23	4.07	3.87	4.25
4.05	2.65	2.15	2.20	2.30			

QUALITY FOR INFLOW POINT-1 SUSPENDED SOLIDS MG/L

8.31	7.67	5.69	6.02	5.05	4.11	3.53	3.13
3.19	1.07	1.62	3.06	2.64	2.44	2.15	2.06
2.01	1.99	1.91	1.72	1.52	1.31	1.19	0.35
0.58	2.72	1.71	1.22	1.03	0.92	0.83	0.72
0.61	0.24	0.63	0.52	0.52	0.39	0.40	0.40
0.27	0.98	1.00	27.88	87.40	107.84	87.53	28.48
19.92	30.36	36.15	113.29	62.77	25.37	16.69	12.65
9.69	8.03	7.16	33.82	20.70	8.19	5.93	5.11
4.69	4.47	3.91	3.48	3.38	1.58	2.85	2.56
2.60	2.40	2.42	1.96	2.01	1.74	1.56	1.46
1.36	1.39	1.27	1.26	1.15	1.15	0.67	1.06
0.91	1.23	1.06	1.01	0.80	1.28	1.06	0.95
0.86	0.63	0.85	3.25	21.63	10.39	11.64	5.40
2.45	4.10	4.27	2.06	1.71	1.78	1.83	2.78
3.93	3.81	3.01	2.53	2.42	2.74	2.37	2.71
2.94	2.97	3.21	3.01	3.03	3.75	4.17	3.43
2.73	3.01	2.56	2.46	2.81	3.41	3.42	3.52
3.54	2.98	2.84	3.28	4.54	5.49	4.86	5.72
7.73	6.07	4.26	5.60	4.60	3.03	2.75	2.49
2.33	2.06	2.09	2.33	1.56	1.45	1.43	1.42
1.83	2.13	2.12	1.89	1.88	1.87	2.00	1.92
2.32	3.91	4.11	3.48	2.12	1.95	1.29	2.87
1.72	1.26	0.92	3.30	1.19	0.99	0.89	0.92
0.96	0.98	1.01	1.19	1.05	1.24	1.25	1.28
1.31	1.35	1.35	1.40	1.43	1.42	1.44	1.68
1.70	1.76	1.54	1.79	1.79	1.83	1.81	1.87
1.82	1.88	1.88	1.90	1.95	0.72	0.73	0.73
0.75	0.99	0.98	0.77	1.05	1.07	0.53	0.81
1.07	0.80	1.07	1.08	0.82	1.12	1.12	1.10
1.14	1.12	1.16	1.16	1.21	1.21	1.20	1.20
0.84	0.92	0.86	0.87	0.89	1.16	0.91	0.90
1.20	0.92	0.92	1.22	1.61	0.93	0.93	0.92

1.22	0.95	0.87	0.89	1.37	1.58	1.41	1.10
1.11	0.83	1.32	0.82	0.82	1.59	1.07	1.33
0.80	1.11	0.82	0.82	0.82	0.84	0.23	1.78
1.11	1.12	1.14	1.11	1.11	1.07	0.81	0.83
0.84	0.83	0.82	1.04	0.80	2.85	4.47	5.95
1.47	1.04	1.37	0.78	1.06	7.07	2.13	1.40
1.43	0.97	0.82	0.84	0.84	0.84	0.89	1.08
0.87	0.89	0.66	0.66	0.67	0.68	0.71	0.68
6.79	8.00	2.55	1.27	1.23	0.74	0.76	0.64
0.66	0.66	1.61	3.23	3.88	1.05	1.58	1.24
1.53	5.17	1.16	2.63	0.57	0.84	0.66	0.70
0.63	0.64	0.94	0.64	33.30	200.06	115.70	8.31
11.13	18.66	14.38	8.45	3.83	1.80	1.30	0.93
0.75	0.56	0.35	0.83	0.85			

INFLOW QUANTITY FROM INFLOW POINT - 2 1992 CFS

585.60	526.00	511.20	532.40	486.70	433.30	407.80	371.60
369.20	364.90	369.30	355.50	336.70	328.00	308.40	299.10
303.60	305.30	288.20	282.00	265.40	249.50	242.70	247.00
250.30	305.10	276.90	262.20	244.60	234.90	225.80	210.20
203.20	204.50	193.50	183.20	179.10	175.90	168.80	171.10
160.70	159.50	151.40	550.70	1546.00	1684.00	1899.00	1207.00
872.40	1122.00	1322.00	2025.00	1429.00	1131.00	973.00	817.80
693.60	603.10	529.90	1043.00	775.60	640.30	537.40	493.90
456.70	432.00	399.00	390.50	397.40	424.70	388.00	372.20
365.80	348.70	350.80	332.70	324.10	306.90	292.00	289.80
288.90	278.60	275.60	273.30	266.40	264.20	274.20	252.40
271.90	286.90	270.90	291.40	296.40	274.30	272.40	267.50
251.50	245.70	245.90	332.00	625.10	503.80	596.10	575.20
441.40	376.10	355.80	337.80	327.50	321.50	322.60	365.60
415.90	412.30	416.00	399.80	397.20	398.90	391.40	393.80
398.30	400.00	404.70	394.20	401.10	417.50	439.60	417.10
373.20	364.20	375.20	376.20	395.50	410.40	414.50	416.70
444.70	441.10	421.40	413.50	469.50	484.60	481.20	513.90
567.30	528.20	454.10	415.30	390.90	377.90	367.20	357.00
341.40	327.40	333.40	309.30	284.00	274.10	270.60	266.10
274.30	288.10	280.80	279.30	280.90	282.20	285.20	277.70
288.60	381.90	348.90	283.20	247.00	227.70	214.40	203.80
243.70	240.70	233.00	251.10	216.10	187.60	177.50	164.70
151.70	146.10	135.70	129.10	125.80	119.00	116.50	114.50
106.50	100.80	100.80	91.07	87.51	87.29	84.43	80.48
78.58	74.08	74.39	70.29	72.25	67.25	69.63	64.22
67.76	62.89	63.52	62.14	56.31	60.57	60.39	59.26
56.02	56.35	56.38	50.20	48.04	46.05	49.50	47.41
45.67	46.39	45.72	42.93	42.23	39.72	40.20	42.20
39.56	40.94	38.06	38.25	34.91	33.45	33.74	34.03
41.55	30.84	37.80	36.68	34.15	37.19	32.46	34.34
34.09	31.54	32.56	31.29	32.98	32.67	32.85	36.17
32.64	30.27	37.23	34.83	50.51	50.65	43.21	43.47
40.46	41.05	50.82	45.03	42.44	58.29	45.20	48.60
51.40	44.81	43.65	42.73	44.66	43.30	58.46	57.75
50.01	46.45	43.36	42.86	39.42	41.67	42.00	38.77
37.70	40.17	42.07	43.68	41.61	57.52	87.32	127.40
60.65	62.55	73.89	54.35	51.81	217.10	160.70	104.80
85.68	73.36	66.46	62.17	60.86	58.39	49.48	54.89

52.67	50.21	51.44	52.71	48.30	42.87	40.87	44.48
145.00	286.30	164.40	114.20	93.06	84.18	78.69	71.38
67.75	68.40	76.82	144.90	208.80	160.40	128.50	115.70
160.80	293.20	272.10	289.40	190.40	154.60	138.80	129.20
119.10	120.80	112.90	119.70	648.60	2123.00	1290.00	583.00
446.50	500.10	794.10	556.70	386.90	315.40	280.80	270.80
244.40	223.50	207.90	191.40	177.70			

TEMPERATURE INFLOW FOR INFLOW POINT - 2 CELSIUS

3.70	3.40	3.60	4.30	3.90	2.80	2.60	3.80
4.20	4.40	4.40	4.10	3.70	4.00	4.10	4.70
5.10	4.40	3.70	3.90	3.70	3.70	4.90	5.10
5.20	4.60	4.00	4.40	3.60	3.80	3.50	3.20
3.60	3.90	3.00	1.90	2.40	3.10	2.70	3.40
2.70	2.70	3.50	5.00	5.70	6.20	6.40	6.10
6.30	7.00	7.40	5.90	4.50	4.10	4.00	5.00
5.40	5.60	5.90	6.00	5.60	5.60	5.60	4.90
5.10	5.50	6.40	7.00	7.00	6.30	4.90	5.90
5.80	4.60	4.40	4.00	4.70	4.90	4.70	4.60
5.00	5.40	5.90	6.10	5.90	5.70	4.50	4.10
3.20	3.50	3.80	4.00	4.20	4.50	4.20	4.20
4.70	4.90	5.20	5.70	5.80	5.80	6.00	5.30
4.60	5.20	6.10	6.10	5.90	6.50	7.00	7.40
7.40	7.10	7.00	6.80	7.20	7.30	6.60	7.60
7.50	7.50	7.80	7.10	7.60	8.20	8.10	6.30
5.90	6.90	7.30	8.00	8.40	8.50	8.20	8.60
7.80	7.30	7.90	9.10	9.80	9.20	9.20	9.90
10.40	8.60	7.50	7.60	8.30	8.90	8.70	9.30
8.30	7.30	7.20	7.10	8.60	9.20	9.30	10.40
11.60	11.10	10.90	10.50	11.20	12.40	13.00	13.20
13.60	12.80	12.80	13.40	13.40	13.30	13.40	12.90
12.90	12.90	11.80	11.50	12.20	12.40	11.90	11.30
11.00	12.00	13.00	12.80	13.00	13.40	14.20	15.10
15.10	14.80	14.90	13.60	13.20	14.60	15.60	16.10
16.10	15.60	15.40	15.40	16.00	16.50	17.00	17.00
17.40	17.80	18.20	17.50	16.00	14.40	13.70	14.90
15.30	16.00	16.00	17.20	16.80	15.70	15.60	14.80
15.30	15.20	15.30	14.80	15.10	15.50	16.50	16.50
16.50	16.90	17.20	16.80	16.60	15.70	14.80	14.30
15.10	14.60	14.50	15.00	15.40	15.20	13.90	14.00
14.30	14.10	14.80	14.80	13.50	12.00	13.60	13.00
11.90	10.80	11.30	11.80	11.50	11.50	10.90	11.10
11.60	11.90	13.20	12.20	10.70	10.80	11.10	10.10
8.80	8.80	9.30	11.00	10.60	9.10	9.10	8.30
8.50	8.40	8.50	8.80	9.10	9.10	9.60	9.80
9.60	9.40	7.40	7.10	8.60	10.00	10.30	9.90
9.10	9.60	8.20	6.70	6.40	7.80	8.00	6.60
6.30	4.80	5.50	6.80	6.20	6.90	4.70	4.50
4.10	2.90	2.50	3.30	2.70	1.90	1.70	3.00
5.40	5.10	4.20	4.20	4.50	4.00	4.40	3.00
3.30	4.10	5.60	5.60	5.00	4.10	3.90	4.30
5.30	5.50	5.80	4.60	3.40	2.10	2.20	2.50
2.60	3.50	3.60	4.10	4.80	5.60	5.10	4.90
5.20	5.00	5.30	4.20	4.00	3.40	3.60	4.30
3.50	2.40	1.90	2.00	2.10			

QUALITY FOR INFLOW POINT-2 SUSPENDED SOLIDS MG/L

1.55	1.46	0.15	0.73	0.15	0.16	0.16	0.17
0.17	0.17	0.17	0.17	0.17	0.18	0.18	0.18
0.18	0.18	0.37	0.19	0.19	0.19	0.20	0.20
0.19	0.54	0.56	0.19	0.20	0.20	0.20	0.21
0.21	0.21	0.21	0.22	0.22	0.22	0.23	0.22
0.23	0.23	0.24	2.73	46.48	10.54	31.75	2.83
9.06	6.92	2.27	13.16	3.51	7.23	1.28	0.37
0.26	0.28	0.15	0.79	0.51	0.27	0.29	0.15
0.15	0.16	0.16	0.16	0.16	0.48	0.33	0.17
0.34	0.34	0.51	0.17	0.35	0.18	0.18	0.18
0.18	0.19	0.19	0.19	0.19	0.19	1.50	0.19
0.19	0.55	0.19	0.37	0.00	0.38	0.19	0.19
0.19	0.20	0.20	0.35	2.61	2.83	3.91	0.28
0.47	0.50	0.34	0.17	0.18	0.18	0.18	0.50
0.96	0.96	0.16	0.16	0.16	0.16	0.16	0.16
0.00	0.16	0.16	0.16	0.16	0.00	0.16	0.16
0.33	0.34	0.17	0.33	0.33	0.32	0.16	0.16
0.00	0.16	0.16	0.00	0.31	0.60	0.15	0.00
0.00	0.15	0.31	0.32	0.16	0.17	0.17	0.17
0.17	0.18	0.17	0.90	0.19	0.19	0.19	0.19
0.19	0.18	0.37	0.19	0.00	0.19	0.18	0.19
0.18	0.33	0.34	2.96	0.20	0.20	0.21	2.52
0.20	0.59	0.20	0.19	0.21	0.22	0.22	0.23
0.23	0.24	0.24	0.25	0.25	0.26	0.26	0.26
0.27	0.27	0.27	0.29	0.29	0.29	0.29	0.30
0.30	0.31	0.31	0.31	0.31	0.32	0.32	0.33
0.32	0.33	0.33	0.33	0.34	0.33	0.33	0.34
0.34	0.34	0.34	0.36	0.36	0.37	0.36	0.37
0.37	0.37	0.37	0.38	0.38	0.39	0.39	0.38
0.39	0.39	0.40	0.40	0.41	0.42	0.42	0.41
0.38	0.43	0.40	0.40	0.41	0.40	0.42	0.41
0.41	0.43	0.42	0.43	0.42	0.42	0.42	0.40
0.42	0.43	0.40	0.41	0.36	0.36	0.38	0.38
0.39	0.39	0.36	0.37	0.38	0.34	0.37	0.36
0.35	0.37	0.38	0.38	0.37	0.38	0.34	0.34
0.36	0.37	0.38	0.38	0.39	0.38	0.38	0.39
0.40	0.39	0.38	0.38	0.38	0.68	0.58	0.75
0.33	0.33	0.31	0.35	0.35	2.05	2.30	0.81
0.58	0.31	0.32	0.33	0.33	0.67	0.36	0.35
0.35	0.36	0.35	0.35	0.36	0.38	0.39	0.37
0.96	2.58	2.51	0.78	0.28	0.29	0.30	0.31
0.32	0.32	0.61	0.72	2.08	0.92	1.50	0.78
0.46	4.02	0.94	0.18	0.86	1.17	0.49	0.25
0.26	0.26	0.53	0.26	2.03	26.21	24.37	7.60
2.96	6.72	0.50	0.43	2.47	0.53	0.37	0.19
0.20	0.20	0.21	0.21	0.22			

OUTFLOW QUANTITY FROM PORT 1 CFS

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	500.00	0.00	0.00	0.00
0.00	281.00	283.00	159.00	66.00	0.00	133.00	180.00
363.00	403.00	467.00	404.00	371.00	400.00	398.00	449.00
384.00	298.00	244.00	203.00	222.00	204.00	224.00	244.00
275.00	305.00	411.00	437.00	378.00	326.00	326.00	371.00
395.00	396.00	398.00	401.00	421.00	500.00	500.00	500.00
500.00	500.00	500.00	500.00	500.00	500.00	500.00	500.00
500.00	500.00	500.00	500.00	500.00	500.00	500.00	500.00
500.00	500.00	500.00	500.00	500.00	500.00	500.00	500.00
500.00	500.00	500.00	500.00	500.00	500.00	500.00	500.00
500.00	500.00	500.00	500.00	500.00	500.00	500.00	500.00
500.00	500.00	500.00	500.00	500.00	500.00	500.00	500.00
500.00	500.00	500.00	500.00	500.00	500.00	500.00	500.00
500.00	480.00	500.00	500.00	500.00	500.00	500.00	500.00
500.00	500.00	500.00	500.00	471.00	389.00	349.00	313.00
297.00	284.00	429.00	315.00	459.00	340.00	267.00	257.00
241.00	205.00	188.00	181.00	175.00	173.00	172.00	169.00
166.00	163.00	158.00	157.00	154.00	150.00	147.00	147.00
148.00	148.00	147.00	147.00	141.00	139.00	135.00	131.00
128.00	123.00	120.00	117.00	114.00	108.00	104.00	102.00
96.00	95.00	94.00	92.00	89.00	86.00	84.00	83.00
81.00	81.00	80.00	78.00	76.00	74.00	73.00	71.00
68.00	67.00	66.00	64.00	65.00	64.00	60.00	59.00
58.00	57.00	59.00	59.00	57.00	57.00	56.00	55.00
54.00	52.00	51.00	50.00	49.00	48.00	48.00	47.00
100.00	102.00	102.00	103.00	120.00	134.00	135.00	136.00
169.00	183.00	200.00	207.00	214.00	217.00	224.00	226.00
228.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00			

OUTFLOW QUANTITY FROM PORT 2 CFS

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	500.00	500.00	500.00	490.00	500.00
500.00	500.00	500.00	500.00	500.00	500.00	500.00	500.00
335.00	296.00	231.00	190.00	143.00	115.00	118.00	68.00
127.00	155.00	172.00	183.00	150.00	142.00	106.00	86.00
56.00	54.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	500.00	500.00	500.00

500.00	500.00	500.00	399.00	321.00	280.00	239.00	213.00
292.00	500.00	500.00	500.00	500.00	500.00	500.00	500.00
500.00	500.00	500.00	500.00	470.00	500.00	500.00	500.00
500.00	500.00	472.00	422.00	465.00	500.00	500.00	500.00
500.00	500.00	500.00	500.00	462.00	500.00	500.00	500.00
500.00	500.00	500.00	500.00	424.00	332.00	296.00	280.00
262.00	208.00	190.00	189.00	135.00	63.00	31.00	31.00
80.00	0.00	88.00	136.00	91.00	46.00	46.00	46.00
47.00	31.00	138.00	299.00	74.00	72.00	65.00	70.00
76.00	80.00	116.00	84.00	131.00	107.00	88.00	85.00
74.00	69.00	67.00	64.00	64.00	67.00	70.00	73.00
76.00	79.00	83.00	87.00	90.00	92.00	95.00	95.00
101.00	107.00	113.00	119.00	123.00	128.00	132.00	136.00
139.00	144.00	147.00	150.00	151.00	146.00	146.00	146.00
142.00	146.00	148.00	150.00	151.00	150.00	152.00	153.00
155.00	158.00	159.00	161.00	162.00	162.00	163.00	165.00
167.00	167.00	169.00	171.00	178.00	181.00	174.00	175.00
176.00	177.00	178.00	181.00	185.00	185.00	186.00	187.00
186.00	187.00	188.00	189.00	188.00	188.00	188.00	189.00
136.00	134.00	134.00	132.00	144.00	158.00	157.00	156.00
202.00	225.00	247.00	256.00	249.00	245.00	236.00	233.00
230.00	456.00	455.00	455.00	459.00	462.00	459.00	334.00
340.00	337.00	317.00	305.00	293.00	276.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00			

OUTFLOW QUANTITY FROM PORT 3 (FLOODGATE) CFS

1830.00	1830.00	1800.00	1360.00	1240.00	1120.00	1000.00	945.00
833.00	823.00	817.00	803.00	796.00	751.00	725.00	687.00
655.00	701.00	715.00	681.00	657.00	610.00	575.00	561.00
580.00	583.00	784.00	706.00	644.00	559.00	490.00	390.00
274.00	238.00	237.00	201.00	167.00	170.00	172.00	168.00
163.00	165.00	167.00	140.00	107.00	454.00	2220.00	2800.00
2810.00	3090.00	4280.00	3840.00	4250.00	3230.00	1840.00	658.00
598.00	896.00	1090.00	1310.00	1160.00	178.00	154.00	275.00
278.00	0.00	0.00	0.00	0.00	76.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	540.00	690.00	780.00
960.00	520.00	150.00	0.00	0.00	0.00	0.00	0.00
0.00	170.00	350.00	230.00	100.00	0.00	30.00	50.00
120.00	260.00	240.00	140.00	0.00	170.00	250.00	360.00
320.00	90.00	0.00	0.00	0.00	0.00	80.00	120.00
60.00	170.00	180.00	40.00	0.00	170.00	310.00	230.00
250.00	420.00	400.00	50.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	124.00
144.00	166.00	184.00	198.00	214.00	229.00	505.00	502.00
498.00	498.00	495.00	499.00	489.00	487.00	496.00	503.00
502.00	504.00	504.00	502.00	509.00	508.00	508.00	551.00
584.00	582.00	578.00	584.00	588.00	583.00	585.00	592.00
588.00	583.00	579.00	576.00	575.00	579.00	579.00	575.00
508.00	397.00	498.00	624.00	354.00	347.00	346.00	291.00
225.00	225.00	225.00	225.00	348.00	652.00	577.00	408.00
311.00	420.00	770.00	827.00	835.00	836.00	830.00	755.00
584.00	357.00	330.00	333.00	302.00	1060.00	2120.00	1540.00
1800.00	1790.00	1770.00	2000.00	2250.00	2210.00	1930.00	1770.00
1110.00	603.00	554.00	468.00	469.00			

STOP

APPENDIX E: EXAMPLF OUTPUT:

PREDICTION MODE

Note: This output will be produced by using the example input file shown in Appendix B. Only portions of the output are provided.

EXAMPLE OUTPUT: PREDICTION MODE

ANONYMOUS RESERVOIR EXAMPLE INPUT DATA

1992 - HYDROLOGY

1992 - METEOROLOGY

PREDICTION MODE

QUALITIES	1	
INFLOW POINTS	2	
MAXIMUM LAYERS	60	
LAYER THICKNESS	4.	FEET
BOTTOM ELEVATION	1776.	FEET
NUMBER OF PORTS	5	
BETA	.20	
LAMBDA	.20	
MIXING COEF.	20.00	
MIXING DECAY COEF.	.5E+10	
ENTRAINMENT COEF.	.30	
DATA INTERVAL	1 - 365	
SIMULATION INTERVAL	1 - 365	

PORT NUMBER	PORT AREA (SQ. FT.)	PORT HEIGHT (FT. FROM BOTTOM)	MAXIMUM FLOW (CFS)	MINIMUM FLOW (CFS)	WETWELL NUMBER	LAYER NUMBER
1	30.	189.0	500.	1.	1	48
2	30.	177.7	500.	1.	2	45
3	30.	157.0	300.	1.	1	40
4	50.	122.2	300.	1.	2	31
5	50.	65.0	300.	1.	1	17
FLOOD GATE	57.0	3.0	4500.0	.0		1

SELECTIVE WITHDRAWAL CAPACITY 1000. CFS

INITIAL DEPTH 125.80 FEET

ANONYMOUS RESERVOIR EXAMPLE INPUT DATA
1992N - HYDROLOGY
1992N - METEOROLOGY

DAY	POOL ELEV (FT)	INFLOW TEMP (DEG-C)	INFLOW QUAL-1 (MG/L)	INFLOW QUANTITY (CFS)	TARGET TEMP (DEG-C)	RELEASE TEMP (DEG-C)	RELEASE QUAL-1 (MG/L)	OUTFLOW QUANTITY (CFS)	PORT	- FLOW (CFS)	PORT	- FLOW (CFS)	PORT	- FLOW (CFS)
1	1900.1	4.65	8.3	858.	3.00	5.21	25.3	1830.	6	1830.				
		3.70	1.5	586.										
2	1897.3	3.80	7.7	732.	3.00	4.75	20.8	1830.	6	1830.				
		3.40	1.5	526.										
3	1894.4	3.70	5.7	701.	3.00	4.78	22.5	1800.	6	1800.				
		3.60	.2	511.										
4	1893.8	4.20	6.0	712.	3.00	4.74	22.2	1360.	6	1360.				
		4.30	.7	532.										
5	1893.2	4.10	5.1	629.	3.00	4.73	22.4	1240.	6	1240.				
		3.90	.2	487.										
6	1892.6	3.20	4.1	561.	3.00	4.69	22.0	1120.	6	1120.				
		2.80	.2	433.										
7	1892.3	2.70	3.5	526.	3.00	4.68	22.0	1000.	6	1000.				
		2.60	.2	408.										
8	1891.8	3.75	3.1	476.	3.00	4.64	21.3	945.	6	945.				
		3.80	.2	372.										
9	1891.7	4.20	3.2	456.	3.00	4.60	20.7	833.	6	833.				
		4.20	.2	369.										
10	1891.6	4.40	1.1	439.	3.00	4.52	19.2	823.	6	823.				
		4.40	.2	365.										
11	1891.6	4.40	1.6	437.	3.00	4.43	17.4	817.	6	817.				
		4.40	.2	369.										
12	1891.5	4.25	3.1	428.	3.00	4.32	15.1	803.	6	803.				
		4.10	.2	356.										
13	1891.3	3.75	2.6	414.	3.00	4.17	12.3	796.	6	796.				
		3.70	.2	337.										
14	1891.2	3.95	2.4	406.	3.00	4.03	9.9	751.	6	751.				
		4.00	.2	328.										

**** Similar output is provided from Simulation Day 15 - 195. ****

ANONYMOUS RESERVOIR EXAMPLE INPUT DATA
1992H - HYDROLOGY
1992H - METEOROLOGY

DAY	POOL ELEV (FT)	INFLOW TEMP (DEG-C)	INFLOW QUAL-1 (MG/L)	INFLOW QUANTITY (CFS)	TARGET TEMP (DEG-C)	RELEASE TEMP (DEG-C)	RELEASE QUAL-1 (MG/L)	OUTFLOW QUANTITY (CFS)	PORT	- FLOW (CFS)	PORT	- FLOW (CFS)	PORT	- FLOW (CFS)
196	1985.9	14.65	1.4	74.	12.78	12.86	2.0	244.	2	176.	3	68.		
		13.60	.3	91.										
197	1985.7	14.15	1.4	70.	12.78	12.86	2.0	244.	2	172.	3	72.		
		13.20	.3	88.										
198	1985.6	15.35	1.4	71.	12.78	12.87	2.0	242.	2	167.	3	75.		
		14.60	.3	87.										
199	1985.4	16.40	1.4	69.	12.78	12.87	2.1	242.	2	162.	3	80.		
		15.60	.3	84.										
200	1985.2	16.80	1.7	65.	12.78	12.92	2.1	242.	2	158.	3	84.		
		16.10	.3	80.										
201	1985.0	16.85	1.7	63.	12.[illegible]	[illegible].95	2.1	249.	2	158.	3	91.		
		16.10	.3	79.										
202	1984.8	16.50	1.8	59.	[illegible]	12.80	2.1	255.	2	156.	3	99.		
		15.60	.3	74.										

ANONYMOUS RESERVOIR EXAMPLE INPUT DATA
1992H - HYDROLOGY
1992H - METEOROLOGY

DAY - 202 21 JUL

INFLOW QUANTITY	58.83	CFS
INFLOW TEMPERATURE	16.50	DEG-C
INFLOW QUALITY - 1	1.76	MG/L
INFLOW QUANTITY	74.08	CFS
INFLOW TEMPERATURE	15.60	DEG-C
INFLOW QUALITY - 1	.31	MG/L
EQUILIBRIUM TEMPERATURE	76.00	DEG-F
HEAT EXCHANGE COEFFICIENT	109.30	BTU/DEG-F
SHORT WAVE RADIATION	2555.00	BTU
POOL ELEVATION	208.76	FEET
TARGET TEMPERATURE	12.78	DEG-C
RELEASE TEMPERATURE	12.80	DEG-C
RELEASE QUALITY - 1	2.10	MG/L
OUTFLOW QUANTITY	255.00	CFS
OUTFLOW PORT - 2	155.88	CFS
OUTFLOW PORT - 3	99.12	CFS

ANONYMOUS RESERVOIR EXAMPLE INPUT DATA
1992H - HYDROLOGY
1992H - METEOROLOGY

DAY - 202   21 JUL

	LAYER	ELEVATION	DEPTH	INFLOW	WITHDRAWAL	VELOCITY	TEMPERATURE	QUALITY-1
	53	1984.8	.0	-42.	.00	.00	22.66	2.1
	52	1982.0	4.0	0.	.00	.00	22.66	2.1
	51	1978.0	8.0	0.	.00	.00	22.66	2.1
	50	1974.0	12.0	0.	.00	.00	22.66	2.1
	49	1970.0	16.0	0.	.00	.00	21.66	2.0
	48	1966.0	20.0	76.	4.19	.11	19.71	1.7
	47	1962.0	24.0	96.	20.91	.54	18.13	1.5
	46	1958.0	28.0	0.	34.32	.88	16.77	1.5
X	45	1954.0	32.0	0.	38.85	1.00	15.51	1.4
	44	1950.0	36.0	0.	33.48	.86	14.14	1.5
	43	1946.0	40.0	0.	21.96	.57	12.43	1.8
	42	1942.0	44.0	0.	18.45	.47	10.61	2.1
	41	1938.0	48.0	0.	19.67	.51	9.22	2.6
X	40	1934.0	52.0	0.	20.73	.53	8.31	3.1
	39	1930.0	56.0	0.	17.35	.45	8.00	3.3
	38	1926.0	60.0	0.	12.75	.33	7.84	3.5
	37	1922.0	64.0	0.	7.88	.20	7.69	3.6
	36	1918.0	68.0	0.	3.80	.10	7.58	3.8
	35	1914.0	72.0	0.	.67	.02	7.41	4.2
	34	1910.0	76.0	0.	.00	.00	7.33	3.8
	33	1906.0	80.0	0.	.00	.00	7.16	6.3
	32	1902.0	84.0	0.	.00	.00	7.07	4.7
	31	1898.0	88.0	0.	.00	.00	7.09	6.7
	30	1894.0	92.0	0.	.00	.00	6.79	5.4
	29	1890.0	96.0	0.	.00	.00	6.79	5.4
	28	1886.0	100.0	0.	.00	.00	6.48	4.9
	27	1882.0	104.0	0.	.00	.00	6.48	4.9
	26	1878.0	108.0	0.	.00	.00	6.48	4.9
	25	1874.0	112.0	0.	.00	.00	6.24	4.9
	24	1870.0	116.0	0.	.00	.00	6.24	4.9
	23	1866.0	120.0	0.	.00	.00	6.02	5.2
	22	1862.0	124.0	0.	.00	.00	6.02	5.2
	21	1858.0	128.0	0.	.00	.00	6.02	5.2
	20	1854.0	132.0	0.	.00	.00	5.86	5.3
	19	1850.0	136.0	0.	.00	.00	5.86	5.3
	18	1846.0	140.0	0.	.00	.00	5.73	5.4
	17	1842.0	144.0	0.	.00	.00	5.73	5.4
	16	1838.0	148.0	0.	.00	.00	5.62	5.5
	15	1834.0	152.0	0.	.00	.00	5.62	5.5
	14	1830.0	156.0	0.	.00	.00	5.62	5.5
	13	1826.0	160.0	0.	.00	.00	5.52	5.9
	12	1822.0	164.0	0.	.00	.00	5.52	5.9
	11	1818.0	168.0	0.	.00	.00	5.44	5.9
	10	1814.0	172.0	0.	.00	.00	5.44	5.9
	9	1810.0	176.0	0.	.00	.00	5.44	5.9
	8	1806.0	180.0	0.	.00	.00	5.37	8.8
	7	1802.0	184.0	0.	.00	.00	5.37	8.8
	6	1798.0	188.0	0.	.00	.00	5.37	8.8
	5	1794.0	192.0	0.	.00	.00	5.24	17.0
	4	1790.0	196.0	0.	.00	.00	5.24	17.0
	3	1786.0	200.0	0.	.00	.00	5.21	34.3
	2	1782.0	204.0	0.	.00	.00	5.21	82.2
	1	1776.0	208.0	0.	.00	.00	5.21	82.2

ANONYMOUS RESERVOIR EXAMPLE INPUT DATA
1992H - HYDROLOGY
1992H - METEOROLOGY

DAY - 202   21 JUL

TEMPERATURE (DEG-C)

```
                  0         5        10        15        20        25        30        35        40        45
      50
                  I---------I---------I---------I---------I---------I---------I---------I---------I---------
I---------I
1985.          0. +           X                                  T
1981.          4. +           X                                  T
1977.          8. +           X                                  T
1973.         12. +           X                                  T
1969.         16. +          X                                 T
1965.         20. +         X                              T
1961.         24. +        X                            T
1957.         28. +        X                         T
1953.         32. +        X                       T
1949.         36. +        X                    T
1945.         40. +         X               T
1941.         44. +           X          T
1937.         48. +             X     T
1933.         52. +                XT
1929.         56. +                 X
1925.         60. +                T X
1921.         64. +                T X
1917.         68. +                T  X
1913.         72. +               T      X
1909.         76. +               T    X
1905.         80. +               T                X
1901.         84. +               T        X
1897.         88. +               T                  X
1893.         92. +              T             X
1889.         96. +              T             X
1885.        100. +             T           X
1881.        104. +             T           X
1877.        108. +             T           X
1873.        112. +             T           X
1869.        116. +             T           X
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1865.       120. +             T             X
1861.       124. +             T             X
1857.       128. +             T             X
1853.       132. +            T              X
1849.       136. +            T              X
1845.       140. +            T               X
1841.       144. +            T               X
1837.       148. +            T               X
1833.       152. +            T               X
1829.       156. +            T               X
1825.       160. +            T                 X
1821.       164. +            T                 X
1817.       168. +           T                  X
1813.       172. +           T                  X
1809.       176. +           T                  X
1805.       180. +           T                                X
1801.       184. +           T                                X
1797.       188. +           T                                X
1793.       192. +           T                                                                         X
1789.       196. +           T                                                                         X
1785.       200. +           T
         *
1781.       204. +           T .
         *
1777.       208. +           T
         *
                 I---------I---------I---------I---------I---------I---------I---------I---------I---------I---------
I---------I
                 0         2         4         6         8         10        12        14        16        18
      20
                                                         QUALITY - 1   ( MG/L )
```

**** Similar output is provided from Simulation Day 203 - 363. ****

ANONYMOUS RESERVOIR EXAMPLE INPUT DATA
1992H - HYDROLOGY
1992H - METEOROLOGY

DAY	POOL ELEV (FT)	INFLOW TEMP (DEG-C)	INFLOW QUAL-1 (MG/L)	INFLOW QUANTITY (CFS)	TARGET TEMP (DEG-C)	RELEASE TEMP (DEG-C)	RELEASE QUAL-1 (MG/L)	OUTFLOW QUANTITY (CFS)	PORT	- FLOW (CFS)	PORT	- FLOW (CFS)	PORT	- FLOW (CFS)
364	1888.6	2.20	.8	283.	3.00	4.56	18.8	468.	6	468.				
		2.00	.2	191.										
365	1888.5	2.30	.9	263.	3.00	4.52	18.1	469.	6	469.				
		2.10	.2	178.										

ANONYMOUS RESERVOIR EXAMPLE INPUT DATA
1992 - HYDROLOGY
1992 - METEOROLOGY

*** RELEASE TEMPERATURE (DEG-C) ***

1	5.2	51	4.5	101	6.9	151	11.2	201	13.0	251	12.9	301	7.1	351	5.4
2	4.7	52	5.2	102	6.0	152	11.3	202	12.8	252	12.8	302	7.4	352	5.5
3	4.8	53	5.3	103	6.0	153	11.3	203	12.8	253	12.8	303	7.6	353	5.5
4	4.7	54	5.1	104	5.9	154	11.3	204	12.9	254	12.9	304	7.9	354	5.3
5	4.7	55	5.1	105	5.9	155	11.4	205	12.9	255	12.9	305	8.2	355	5.4
6	4.7	56	5.1	106	6.4	156	11.3	206	12.9	256	12.9	306	8.1	356	5.0
7	4.7	57	5.1	107	7.0	157	11.4	207	13.0	257	15.1	307	8.3	357	5.1
8	4.6	58	5.1	108	7.5	158	11.6	208	12.9	258	15.2	308	8.6	358	5.0
9	4.6	59	5.1	109	7.5	159	11.9	209	12.9	259	15.2	309	8.7	359	4.8
10	4.5	60	5.4	110	7.3	160	12.1	210	12.9	260	15.1	310	9.0	360	4.8
11	4.4	61	5.5	111	8.0	161	12.3	211	12.9	261	15.1	311	9.0	361	4.6
12	4.3	62	5.5	112	8.3	162	12.7	212	13.0	262	15.1	312	9.0	362	4.6
13	4.2	63	5.6	113	8.3	163	12.3	213	13.0	263	15.1	313	9.1	363	4.6
14	4.0	64	5.5	114	7.8	164	12.3	214	12.9	264	15.1	314	9.2	364	4.6
15	3.9	65	5.5	115	7.4	165	12.7	215	12.9	265	15.1	315	9.3	365	4.5
16	3.8	66	5.8	116	7.7	166	12.9	216	12.9	266	14.6	316	9.4		
17	3.8	67	5.9	117	8.0	167	12.8	217	12.9	267	14.2	317	10.0		
18	3.8	68	6.0	118	8.4	168	13.0	218	12.9	268	14.0	318	9.2		
19	3.7	69	5.9	119	8.3	169	13.0	219	13.1	269	14.1	319	9.3		
20	3.7	70	6.0	120	8.2	170	13.0	220	12.9	270	14.1	320	9.4		
21	3.6	71	6.0	121	8.0	171	13.0	221	12.9	271	14.1	321	8.9		
22	3.6	72	6.0	122	7.8	172	13.2	222	12.9	272	13.8	322	7.2		
23	3.7	73	6.0	123	8.0	173	13.1	223	12.9	273	13.8	323	6.6		
24	3.8	74	6.0	124	8.3	174	12.9	224	12.9	274	13.9	324	6.9		
25	3.8	75	5.9	125	8.8	175	12.9	225	12.9	275	13.7	325	6.6		
26	3.8	76	5.9	126	8.4	176	12.9	226	12.9	276	13.6	326	6.6		
27	3.8	77	5.9	127	8.3	177	12.9	227	12.9	277	13.6	327	6.6		
28	3.8	78	6.2	128	7.9	178	12.9	228	12.8	278	13.6	328	6.2		
29	3.8	79	6.2	129	8.0	179	13.2	229	12.9	279	13.6	329	6.0		
30	3.7	80	6.5	130	8.7	180	12.9	230	12.9	280	11.6	330	6.1		
31	3.7	81	6.5	131	9.1	181	12.4	231	12.9	281	12.0	331	6.4		
32	3.6	82	6.5	132	9.2	182	12.9	232	12.9	282	12.2	332	6.4		
33	3.6	83	6.6	133	9.4	183	12.9	233	12.7	283	12.3	333	6.3		
34	3.6	84	6.6	134	9.4	184	12.9	234	12.9	284	12.5	334	6.2		
35	3.6	85	6.6	135	9.1	185	12.9	235	12.9	285	12.7	335	6.0		
36	3.5	86	6.5	136	9.1	186	12.9	236	12.9	286	12.8	336	5.9		
37	3.5	87	6.5	137	9.4	187	12.9	237	12.9	287	8.5	337	5.9		
38	3.5	88	6.5	138	9.0	188	12.9	238	12.9	288	8.5	338	6.1		
39	.9	89	6.5	139	9.0	189	12.9	239	12.9	289	8.5	339	6.3		
40	1.5	90	6.5	140	9.7	190	12.9	240	12.9	290	8.6	340	6.0		
41	3.5	91	6.7	141	10.2	191	12.9	241	12.9	291	8.8	341	5.5		
42	3.4	92	6.6	142	9.5	192	12.9	242	12.9	292	8.9	342	5.1		
43	2.3	93	6.6	143	9.2	193	12.9	243	12.9	293	9.0	343	5.0		
44	3.7	94	6.6	144	9.7	194	12.9	244	12.9	294	6.3	344	5.0		
45	4.4	95	6.6	145	9.8	195	12.9	245	12.9	295	6.5	345	4.9		
46	5.0	96	6.5	146	9.3	196	12.9	246	13.1	296	6.6	346	4.8		
47	4.8	97	6.5	147	9.3	197	12.9	247	13.0	297	6.7	347	4.9		
48	4.7	98	6.6	148	10.6	198	12.9	248	13.0	298	6.7	348	5.0		
49	4.6	99	7.0	149	11.0	199	12.9	249	12.9	299	6.7	349	5.1		
50	4.4	100	7.2	150	11.2	200	12.9	250	12.9	300	6.8	350	5.6		

ANONYMOUS RESERVOIR EXAMPLE INPUT DATA
1992 - HYDROLOGY
1992 - METEOROLOGY

*** RELEASE QUALITY (MG/L) ***

1	25.3	51	32.8	101	7.2	151	2.9	201	2.1	251	2.3	301	2.5	351	78.9
2	20.8	52	51.8	102	10.6	152	2.8	202	2.1	252	2.4	302	2.6	352	71.4
3	22.5	53	44.4	103	5.9	153	2.7	203	2.1	253	2.4	303	2.7	353	54.3
4	22.2	54	36.5	104	5.7	154	2.7	204	2.1	254	2.4	304	2.7	354	41.1
5	22.4	55	33.3	105	5.4	155	2.6	205	2.1	255	2.5	305	2.5	355	30.1
6	22.0	56	33.4	106	5.8	156	2.6	206	2.1	256	2.5	306	2.2	356	22.1
7	22.0	57	28.5	107	6.3	157	2.5	207	2.2	257	2.1	307	2.2	357	22.9
8	21.3	58	22.3	108	6.4	158	2.5	208	2.2	258	2.1	308	2.3	358	22.5
9	20.7	59	20.1	109	6.1	159	2.4	209	2.2	259	2.1	309	2.3	359	21.0
10	19.2	60	18.7	110	5.7	160	2.4	210	2.2	260	2.1	310	2.3	360	20.5
11	17.4	61	17.9	111	5.6	161	2.3	211	2.3	261	2.0	311	2.3	361	18.3
12	15.1	62	17.3	112	5.4	162	2.3	212	2.3	262	2.0	312	2.3	362	19.4
13	12.3	63	16.4	113	5.2	163	2.2	213	2.3	263	2.0	313	2.2	363	18.5
14	9.9	64	15.9	114	5.0	164	2.2	214	2.3	264	2.0	314	2.2	364	18.8
15	7.4	65	15.0	115	4.6	165	2.2	215	2.3	265	2.0	315	2.1	365	18.1
16	5.4	66	11.9	116	4.4	166	2.1	216	2.3	266	2.1	316	2.1		
17	3.9	67	11.9	117	4.3	167	2.1	217	2.2	267	2.2	317	1.8		
18	3.0	68	11.5	118	4.2	168	2.1	218	2.2	268	2.3	318	2.1		
19	2.4	69	11.2	119	4.1	169	2.1	219	2.2	269	2.3	319	2.0		
20	2.2	70	10.7	120	4.0	170	2.1	220	2.2	270	2.3	320	1.3		
21	1.9	71	10.3	121	4.0	171	2.1	221	2.2	271	2.3	321	2.6		
22	1.9	72	9.6	122	3.8	172	2.2	222	2.2	272	2.3	322	4.1		
23	1.5	73	8.9	123	3.7	173	2.1	223	2.2	273	2.3	323	3.2		
24	1.5	74	8.9	124	3.6	174	2.1	224	2.2	274	2.3	324	2.4		
25	1.5	75	8.9	125	3.5	175	2.1	225	2.2	275	2.3	325	2.1		
26	1.9	76	9.0	126	3.5	176	2.1	226	2.2	276	2.3	326	1.9		
27	1.7	77	8.8	127	3.5	177	2.1	227	2.2	277	2.2	327	1.7		
28	1.6	78	9.3	128	3.5	178	2.0	228	2.2	278	2.2	328	1.6		
29	1.5	79	9.2	129	3.5	179	2.0	229	2.2	279	2.2	329	1.4		
30	1.4	80	9.2	130	3.4	180	2.0	230	2.2	280	2.5	330	1.4		
31	1.4	81	9.0	131	3.2	181	2.2	231	2.1	281	2.4	331	1.5		
32	1.4	82	8.6	132	3.2	182	2.0	232	2.1	282	2.4	332	1.9		
33	1.4	83	8.2	133	3.1	183	2.0	233	2.2	283	2.3	333	2.7		
34	1.5	84	7.9	134	3.1	184	2.0	234	2.1	284	[illegible].3	334	2.1		
35	1.5	85	7.8	135	3.2	185	1.9	235	2.2	285	[illegible].2	335	2.0		
36	1.5	86	7.4	136	3.2	186	1.9	236	2.2	286	2.2	336	1.7		
37	1.6	87	7.4	137	3.1	187	1.9	237	2.2	287	2.3	337	1.6		
38	1.6	88	7.3	138	3.2	188	1.9	238	2.3	288	2.2	338	2.8		
39	.9	89	7.3	139	3.1	189	1.9	239	2.3	289	2.1	339	2.6		
40	.9	90	7.2	140	2.9	190	1.9	240	2.3	290	2.1	340	2.1		
41	1.8	91	7.5	141	2.8	191	1.9	241	2.3	291	2.1	341	1.7		
42	1.7	92	7.3	142	3.2	192	1.9	242	2.3	292	2.1	342	1.6		
43	.8	93	7.4	143	3.2	193	1.9	243	2.3	293	2.1	343	1.5		
44	8.2	94	7.4	144	3.2	194	2.0	244	2.3	294	8.8	344	1.5		
45	48.4	95	7.4	145	3.3	195	2.0	245	2.3	295	3.1	345	1.4		
46	80.6	96	7.3	146	3.5	196	2.0	246	2.3	296	3.0	346	1.3		
47	66.3	97	7.1	147	3.4	197	2.0	247	2.3	297	2.9	347	1.3		
48	58.8	98	7.1	148	3.2	198	2.0	248	2.3	298	2.5	348	1.2		
49	52.6	99	7.2	149	3.1	199	2.1	249	2.3	299	2.5	349	15.3		
50	43.3	100	7.2	150	3.0	200	2.1	250	2.3	300	2.3	350	96.8		

ANONYMOUS RESERVOIR EXAMPLE INPUT DATA
1992 - HYDROLOGY
1992 - METEOROLOGY

*** PORT SELECTION INDICES ***

1	40	51	40	101	45	151	45	201	45	251	45	301	40	351	40
2	40	52	40	102	80	152	25	202	45	252	45	302	40	352	40
3	40	53	40	103	80	153	25	203	45	253	45	303	40	353	40
4	40	54	40	104	30	154	25	204	45	254	45	304	40	354	40
5	40	55	40	105	30	155	25	205	45	255	45	305	40	355	40
6	40	56	40	106	30	156	25	206	45	256	45	306	40	356	40
7	40	57	40	107	30	157	25	207	45	257	45	307	40	357	40
8	40	58	40	108	25	158	25	208	45	258	45	308	40	358	40
9	40	59	40	109	25	159	25	209	45	259	45	309	40	359	40
10	40	60	80	110	25	160	25	210	45	260	45	310	40	360	40
11	40	61	80	111	25	161	25	211	45	261	45	311	40	361	40
12	40	62	45	112	25	162	20	212	45	262	45	312	40	362	40
13	40	63	45	113	25	163	25	213	45	263	45	313	40	363	40
14	40	64	45	114	30	164	25	214	45	264	45	314	40	364	40
15	40	65	45	115	30	165	45	215	45	265	45	315	40	365	40
16	40	66	45	116	30	166	45	216	45	266	45	316	40		
17	40	67	45	117	30	167	45	217	45	267	45	317	40		
18	40	68	45	118	25	168	45	218	45	268	45	318	40		
19	40	69	45	119	30	169	45	219	45	269	45	319	40		
20	40	70	45	120	30	170	45	220	45	270	45	320	40		
21	40	71	45	121	30	171	45	221	45	271	45	321	40		
22	40	72	45	122	30	172	45	222	45	272	45	322	40		
23	40	73	45	123	30	173	45	223	45	273	45	323	40		
24	40	74	45	124	30	174	45	224	45	274	45	324	40		
25	40	75	45	125	25	175	45	225	45	275	45	325	40		
26	40	76	45	126	30	176	45	226	45	276	45	326	40		
27	40	77	45	127	30	177	45	227	45	277	45	327	40		
28	40	78	45	128	30	178	45	228	45	278	45	328	40		
29	40	79	45	129	30	179	45	229	45	279	45	329	40		
30	40	80	45	130	30	180	45	230	45	280	45	330	40		
31	40	81	45	131	25	181	45	231	45	281	45	331	40		
32	40	82	45	132	25	182	45	232	45	282	45	332	40		
33	40	83	45	133	45	183	45	233	45	283	45	333	40		
34	40	84	45	134	25	184	45	234	45	284	45	334	40		
35	40	85	45	135	30	185	45	235	45	285	45	335	40		
36	40	86	45	136	30	186	45	236	45	286	45	336	40		
37	40	87	45	137	30	187	45	237	45	287	45	337	40		
38	40	88	45	138	30	188	45	238	45	288	45	338	40		
39	20	89	45	139	30	189	45	239	45	289	45	339	40		
40	20	90	45	140	30	190	45	240	45	290	45	340	40		
41	40	91	45	141	25	191	45	241	45	291	45	341	40		
42	40	92	45	142	30	192	45	242	45	292	45	342	40		
43	20	93	20	143	30	193	45	243	45	293	45	343	40		
44	40	94	20	144	30	194	45	244	45	294	50	344	40		
45	40	95	20	145	30	195	45	245	45	295	50	345	40		
46	40	96	20	146	30	196	45	246	45	296	50	346	40		
47	40	97	20	147	30	197	45	247	45	297	50	347	40		
48	40	98	20	148	30	198	45	248	45	298	50	348	40		
49	40	99	20	149	45	199	45	249	45	299	50	349	40		
50	40	100	20	150	45	200	45	250	45	300	40	350	40		

ANONYMOUS RESERVOIR EXAMPLE INPUT DATA
1992 - HYDROLOGY
1992 - METEOROLOGY

*** TEMPERATURE DIFFERENCE (RELEASE - TARGET) ***

1	-2.2	51	-1.5	101	.3	151	.2	201	-.2	251	-.1	301	-.6	351	-2.4
2	-1.7	52	-2.2	102	1.2	152	1.4	202	.0	252	-.1	302	-.9	352	-2.5
3	-1.8	53	-2.3	103	1.3	153	1.5	203	.0	253	-.1	303	-1.1	353	-2.5
4	-1.7	54	-2.1	104	2.1	154	1.4	204	-.1	254	-.1	304	-1.4	354	-2.3
5	-1.7	55	-2.1	105	2.1	155	1.4	205	-.1	255	-.2	305	-4.2	355	-2.4
6	-1.7	56	-2.1	106	1.6	156	1.5	206	-.2	256	-.1	306	-4.1	356	-2.0
7	-1.7	57	-2.1	107	1.0	157	1.4	207	-.2	257	-.1	307	-4.3	357	-2.1
8	-1.6	58	-2.1	108	.5	158	1.2	208	-.1	258	-.2	308	-4.6	358	-2.0
9	-1.6	59	-2.1	109	.5	159	.9	209	-.1	259	-.2	309	-4.7	359	-1.8
10	-1.5	60	.2	110	.7	160	.6	210	-.1	260	-.1	310	-5.0	360	-1.8
11	-1.4	61	.1	111	.7	161	.5	211	-.1	261	-.1	311	-6.0	361	-1.6
12	-1.3	62	.1	112	.5	162	.1	212	-.2	262	-.1	312	-6.0	362	-1.6
13	-1.2	63	.1	113	.4	163	.5	213	-.2	263	-.1	313	-6.1	363	-1.6
14	-1.0	64	.1	114	1.0	164	.5	214	-.1	264	-.1	314	-6.2	364	-1.6
15	-.9	65	.1	115	1.4	165	.1	215	-.1	265	-.1	315	-6.3	365	-1.5
16	-.8	66	.0	116	1.1	166	-.1	216	-.1	266	.4	316	-6.4		
17	-.8	67	-.1	117	.8	167	-.1	217	-.1	267	.8	317	-7.0		
18	-.8	68	-.2	118	.4	168	-.2	218	-.1	268	1.0	318	-6.2		
19	-.7	69	-.2	119	.5	169	-.2	219	-.3	269	.9	319	-6.3		
20	-.7	70	-.2	120	.5	170	-.2	220	-.2	270	.9	320	-6.4		
21	-.6	71	-.2	121	1.0	171	-.2	221	-.1	271	.9	321	-5.9		
22	-.6	72	-.2	122	1.2	172	-.5	222	-.1	272	1.2	322	-4.2		
23	-.7	73	.2	123	1.0	173	-.4	223	-.1	273	1.2	323	-3.6		
24	-.8	74	.2	124	.7	174	-.1	224	-.2	274	.1	324	-3.9		
25	-.8	75	.2	125	.2	175	-.1	225	-.1	275	.3	325	-3.6		
26	-.8	76	.2	126	.6	176	-.1	226	-.1	276	.4	326	-3.6		
27	-.8	77	.2	127	1.0	177	-.1	227	-.2	277	.4	327	-3.6		
28	-.8	78	-.1	128	1.4	178	-.1	228	-.1	278	.4	328	-3.2		
29	-.8	79	-.1	129	1.3	179	-.4	229	-.1	279	.4	329	-3.0		
30	-.7	80	.0	130	.6	180	-.1	230	-.1	280	-.6	330	-3.1		
31	-.7	81	.0	131	.2	181	.4	231	-.1	281	-1.0	331	-3.4		
32	-.6	82	.0	132	.1	182	-.1	232	-.1	282	-1.2	332	-3.4		
33	-.6	83	-.1	133	-.1	183	-.1	233	.1	283	-1.3	333	-3.3		
34	-.6	84	-.1	134	.8	184	-.1	234	-.1	284	-1.5	334	-3.2		
35	-.6	85	-.1	135	1.1	185	-.1	235	-.1	285	-1.7	335	-3.0		
36	-.5	86	.0	136	1.1	186	-.1	236	-.1	286	-1.8	336	-2.9		
37	-.5	87	.0	137	.8	187	-.1	237	-.1	287	-.2	337	-2.9		
38	-.5	88	.0	138	1.2	188	-.1	238	-.2	288	-.2	338	-3.1		
39	2.1	89	.0	139	1.2	189	-.1	239	-.1	289	-.2	339	-3.3		
40	1.5	90	.0	140	.6	190	-.1	240	-.1	290	-.3	340	-3.0		
41	-.5	91	.0	141	1.2	191	-.1	241	-.1	291	-.5	341	-2.5		
42	-.4	92	.2	142	1.8	192	-.1	242	-.1	292	-.7	342	-2.1		
43	.7	93	.1	143	2.1	193	-.1	243	-.1	293	-.8	343	-2.0		
44	-.7	94	.1	144	1.7	194	-.1	244	-.1	294	.2	344	-2.0		
45	-1.4	95	.2	145	1.6	195	-.1	245	-.1	295	.0	345	-1.9		
46	-2.0	96	.2	146	2.1	196	-.1	246	-.3	296	-.1	346	-1.8		
47	-1.8	97	.7	147	2.1	197	-.1	247	-.2	297	-.2	347	-1.9		
48	-1.7	98	.6	148	.7	198	-.1	248	-.2	298	-.2	348	-2.0		
49	-1.6	99	.2	149	.3	199	-.1	249	-.1	299	-.2	349	-2.1		
50	-1.4	100	.1	150	.1	200	-.1	250	-.1	300	-.3	350	-2.6		

SUM OF DIFFERENCES	2.30E+02
SUM OF ABSOLUTE DIFFERENCES	3.90E+02
SUM OF SQUARES DIFFERENCES	1.09E+03
MAXIMUM DIFFERENCE	7.0
MAXIMUM 1-DAY TEMPERATURE CHANGE	2.7
AVERAGE DIFFERENCE	.63
AVERAGE ABSOLUTE DIFFERENCE	1.1

APPENDIX F: EXAMPLE OUTPUT:
VERIFICATION MODE

Note: This output will be produced by using the example input file shown in Appendix D. Only portions of the output are provided.

EXAMPLE OUTPUT: VERIFICATION MODE

ANONYMOUS RESERVOIR EXAMPLE INPUT DATA

1992 - HYDROLOGY

1992 - METEOROLOGY

VERIFICATION MODE

QUALITIES	1	
INFLOW POINTS	2	
MAXIMUM LAYERS	60	
LAYER THICKNESS	4.	FEET
BOTTOM ELEVATION	1776.	FEET
NUMBER OF PORTS	3	
BETA	.20	
LAMBDA	.20	
MIXING COEF.	20.00	
MIXING DECAY COEF.	.5E+10	
ENTRAINMENT COEF.	.30	
DATA INTERVAL	1 - 365	
SIMULATION INTERVAL	1 - 365	
INITIAL DEPTH	125.80	FEET

PORT NUMBER	PORT AREA (SQ. FT.)	PORT HEIGHT (FT. FROM BOTTOM)	LAYER NUMBER
1	30.	178.0	45
2	30.	122.0	31
3	57.	3.0	1

ANONYMOUS RESERVOIR EXAMPLE INPUT DATA
1992H - HYDROLOGY
1992H - METEOROLOGY

DAY	POOL ELEV (FT)	INFLOW TEMP (DEG-C)	INFLOW QUAL-1 (MG/L)	INFLOW QUANTITY (CFS)	RELEASE TEMP (DEG-C)	RELEASE QUAL-1 (MG/L)	OUTFLOW QUANTITY (CFS)	PORT - FLOW (CFS)		PORT - FLOW (CFS)	PORT - FLOW (CFS)
1	1900.1	4.65 3.70	8.3 1.5	858. 586.	5.21	25.3	1830.	3	1830.		
2	1897.3	3.80 3.40	7.7 1.5	732. 526.	4.75	20.8	1830.	3	1830.		
3	1894.4	3.70 3.60	5.7 .2	701. 511.	4.78	22.5	1800.	3	1800.		
4	1893.8	4.20 4.30	6.0 .7	712. 532.	4.74	22.2	1360.	3	1360.		
5	1893.2	4.10 3.90	5.1 .2	629. 487.	4.73	22.4	1240.	3	1240.		
6	1892.6	3.20 2.80	4.1 .2	561. 433.	4.69	22.0	1120.	3	1120.		
7	1892.3	2.70 2.60	3.5 .2	526. 408.	4.68	22.0	1000.	3	1000.		
8	1891.8	3.75 3.80	3.1 .2	476. 372.	4.64	21.3	945.	3	945.		
9	1891.7	4.20 4.20	3.2 .2	456. 369.	4.60	20.7	833.	3	833.		
10	1891.6	4.40 4.40	1.1 .2	439. 365.	4.52	19.2	823.	3	823.		
11	1891.6	4.40 4.40	1.6 .2	437. 369.	4.43	17.4	817.	3	817.		
12	1891.5	4.25 4.10	3.1 .2	428. 356.	4.32	15.1	803.	3	803.		
13	1891.3	3.75 3.70	2.6 .2	414. 337.	4.17	12.3	796.	3	796.		
14	1891.2	3.95 4.00	2.4 .2	406. 328.	4.03	9.9	751.	3	751.		

**** Similar output is provided from Simulation Day 15 - 145. ****

ANONYMOUS RESERVOIR EXAMPLE INPUT DATA
1992H - HYDROLOGY
1992H - METEOROLOGY

DAY	POOL ELEV (FT)	INFLOW TEMP (DEG-C)	INFLOW QUAL-1 (MG/L)	INFLOW QUANTITY (CFS)	RELEASE TEMP (DEG-C)	RELEASE QUAL-1 (MG/L)	OUTFLOW QUANTITY (CFS)	PORT	- FLOW (CFS)	PORT	- FLOW (CFS)	PORT	- FLOW (CFS)
147	1988.0	7.50 7.50	4.3 .3	571. 454.	8.54	3.7	1400.	1	500.	2	500.	3	400.
148	1987.7	7.90 7.60	5.6 .3	488. 415.	9.46	3.5	1050.	1	500.	2	500.	3	50.
149	1987.6	8.60 8.30	4.6 .2	446. 391.	9.57	3.4	924.	1	500.	2	424.		
150	1987.5	8.95 8.90	3.0 .2	428. 378.	9.43	3.4	832.	1	500.	2	332.		
151	1987.5	8.75 8.70	2.8 .2	418. 367.	9.37	3.3	796.	1	500.	2	296.		
152	1987.4	9.15 9.30	2.5 .2	400. 357.	9.33	3.2	780.	1	500.	2	280.		
153	1987.4	8.45 8.30	2.3 .2	381. 341.	9.40	3.2	762.	1	500.	2	262.		

ANONYMOUS RESERVOIR EXAMPLE INPUT DATA
1992H - HYDROLOGY
1992H - METEOROLOGY

DAY - 153 2 JUN

INFLOW QUANTITY	381.10	CFS
INFLOW TEMPERATURE	8.45	DEG-C
INFLOW QUALITY - 1	2.33	MG/L
INFLOW QUANTITY	341.40	CFS
INFLOW TEMPERATURE	8.30	DEG-C
INFLOW QUALITY - 1	.17	MG/L
EQUILIBRIUM TEMPERATURE	63.20	DEG-F
HEAT EXCHANGE COEFFICIENT	108.90	BTU/DEG-F
SHORT WAVE RADIATION	2656.90	BTU
POOL ELEVATION	211.37	FEET
RELEASE TEMPERATURE	9.40	DEG-C
RELEASE QUALITY - 1	3.22	MG/L
OUTFLOW QUANTITY	762.00	CFS
OUTFLOW PORT - 1	500.00	CFS
OUTFLOW PORT - 2	262.00	CFS

ANONYMOUS RESERVOIR EXAMPLE INPUT DATA
1992H - HYDROLOGY
1992H - METEOROLOGY

DAY - 153 2 JUN

	LAYER	ELEVATION	DEPTH	INFLOW	WITHDRAWAL	VELOCITY	TEMPERATURE	QUALITY-1
	53	1987.4	.0	-116.	.00	.00	15.41	3.4
	52	1982.0	4.0	0.	.00	.00	15.41	3.4
	51	1978.0	8.0	0.	.00	.00	15.41	3.4
	50	1974.0	12.0	0.	1.68	.03	15.41	3.4
	49	1970.0	16.0	0.	18.17	.37	14.27	3.4
	48	1966.0	20.0	0.	31.39	.63	13.06	3.3
	47	1962.0	24.0	0.	38.61	.78	12.07	3.2
	46	1958.0	28.0	0.	40.83	.82	11.37	3.0
X	45	1954.0	32.0	0.	39.25	.79	10.91	2.8
	44	1950.0	36.0	0.	33.69	.68	10.60	2.8
	43	1946.0	40.0	495.	26.04	.52	10.36	2.8
	42	1942.0	44.0	444.	18.35	.37	10.17	2.6
	41	1938.0	48.0	0.	10.18	.20	9.99	2.9
	40	1934.0	52.0	0.	3.79	.08	9.81	3.0
	39	1930.0	56.0	0.	4.12	.08	9.63	2.9
	38	1926.0	60.0	0.	10.62	.21	9.46	2.9
	37	1922.0	64.0	0.	18.95	.38	9.29	2.9
	36	1918.0	68.0	0.	27.33	.55	9.13	2.9
	35	1914.0	72.0	0.	35.09	.71	8.97	2.9
	34	1910.0	76.0	0.	41.44	.83	8.80	3.0
	33	1906.0	80.0	0.	46.11	.93	8.65	3.1
	32	1902.0	84.0	0.	48.93	.98	8.48	3.1
X	31	1898.0	88.0	0.	49.74	1.00	8.32	3.3
	30	1894.0	92.0	0.	48.25	.97	8.15	3.4
	29	1890.0	96.0	0.	44.44	.89	7.98	3.4
	28	1886.0	100.0	0.	38.61	.78	7.80	3.8
	27	1882.0	104.0	0.	31.41	.63	7.62	3.8
	26	1878.0	108.0	0.	23.57	.47	7.44	4.1
	25	1874.0	112.0	0.	16.10	.32	7.28	4.1
	24	1870.0	116.0	0.	9.46	.19	7.14	4.5
	23	1866.0	120.0	0.	4.46	.09	7.00	3.9
	22	1862.0	124.0	0.	1.39	.03	6.93	5.4
	21	1858.0	128.0	0.	.00	.00	6.77	4.9
	20	1854.0	132.0	0.	.00	.00	6.77	4.9
	19	1850.0	136.0	0.	.00	.00	6.54	4.7
	18	1846.0	140.0	0.	.00	.00	6.54	4.7
	17	1842.0	144.0	0.	.00	.00	6.34	4.9
	16	1838.0	148.0	0.	.00	.00	6.34	4.9
	15	1834.0	152.0	0.	.00	.00	6.33	7.2
	14	1830.0	156.0	0.	.00	.00	6.17	5.1
	13	1826.0	160.0	0.	.00	.00	6.17	5.1
	12	1822.0	164.0	0.	.00	.00	6.02	4.5
	11	1818.0	168.0	0.	.00	.00	6.02	4.5
	10	1814.0	172.0	0.	.00	.00	5.95	4.4
	9	1810.0	176.0	0.	.00	.00	5.90	3.7
	8	1806.0	180.0	0.	.00	.00	5.90	3.7
	7	1802.0	184.0	0.	.00	.00	5.82	2.2
	6	1798.0	188.0	0.	.00	.00	5.77	4.8
	5	1794.0	192.0	0.	.00	.00	5.77	4.8
	4	1790.0	196.0	0.	.00	.00	5.77	4.8
	3	1786.0	200.0	0.	.00	.00	5.64	8.9
	2	1782.0	204.0	0.	.00	.00	5.64	8.9
	1	1776.0	208.0	0.	.00	.00	5.64	8.9

ANONYMOUS RESERVOIR EXAMPLE INPUT DATA
1992H - HYDROLOGY
1992H - METEOROLOGY

DAY - 153   2 JUN

TEMPERATURE (DEG-C)

```
                 0         5        10        15        20        25        30        35        40
45        50
                 I---------I---------I---------I---------I---------I---------I---------I---------I---------I---------
I---------I
1987.         0. +                 X             T
1983.         4. +                 X             T
1979.         8. +                 X             T
1975.        12. +                 X             T
1971.        16. +                 X           T
1967.        20. +                 X         T
1963.        24. +                 X       T
1959.        28. +                X      T
1955.        32. +              X       T
1951.        36. +              X       T
1947.        40. +              X      T
1943.        44. +              X      T
1939.        48. +               X    T
1935.        52. +                X   T
1931.        56. +               X    T
1927.        60. +               X   T
1923.        64. +               X   T
1919.        68. +               X   T
1915.        72. +               X  T
1911.        76. +               X  T
1907.        80. +                X T
1903.        84. +                XT
1899.        88. +                 X
1895.        92. +                 X
1891.        96. +                T X
1887.       100. +                T  X
1883.       104. +                T   X
1879.       108. +               T     X
1875.       112. +               T     X
1871.       116. +               T       X
```

```
1867.       120. +               T    X
1863.       124. +              T             X
1859.       128. +              T          X
1855.       132. +              T          X
1851.       136. +              T         X
1847.       140. +              T         X
1843.       144. +             T           X
1839.       148. +             T           X
1835.       152. +             T                      X
1831.       156. +             T            X
1827.       160. +             T            X
1823.       164. +             T         X
1819.       168. +             T         X
1815.       172. +            T         X
1811.       176. +            T      X
1807.       180. +            T      X
1803.       184. +            X
1799.       188. +            T           X
1795.       192. +            T           X
1791.       196. +            T           X
1787.       200. +            T                                X
1783.       204. +            T                                X
1779.       208. +            T                                X
                 I---------I---------I---------I---------I---------I---------I---------I---------I---------I---------
I---------I
                 0         2         4         6         8        10        12        14        16
18        20
                             QUALITY - 1   ( MG/L )
```

**** Similar output is porvide from Simulatic~ ~·y 154 - 363. ****

ANONYMOUS RESERVOIR EXAMPLE INPUT DATA
1992H - HYDROLOGY
1992H - METFOROLOGY

DAY	POOL ELEV	INFLOW TF .P	INFLOW QUAL-1	INFLOW QUANTITY	RELEASE TEMP	RELEASE QUAL-1	OUTFLOW QUANTITY	PORT	- FLOW	PORT	- FLOW	PORT	- FLOW
	(FT)	(DEG-C)	(MG/L)	(CFS)	(DEG-C)	(MG/L)	(CFS)		(CFS)		(CFS)		(CFS)
364	1888.6	2.20	.8	283.	4.63	19.5	468.	3	468.				
		2.00	.2	191.									
365	1888.5	2.30	.9	263.	4.60	19.2	469.	3	469.				
		2.10	.2	178.									

ANONYMOUS RESERVOIR EXAMPLE INPUT DATA
1992 - METEOROLOGY

1992 - HYDROLOGY

*** RELEASE TEMPERATURE (DEG-C) ***

1	5.2	51	4.5	101	5.5	151	9.4	201	12.9	251	18.8	301	9.6	351	5.5
2	4.7	52	5.2	102	5.7	152	9.3	202	13.0	252	18.7	302	9.5	352	5.5
3	4.8	53	5.2	103	5.7	153	9.4	203	13.2	253	18.7	303	9.5	353	5.5
4	4.7	54	5.1	104	5.6	154	9.2	204	13.4	254	18.6	304	9.3	354	5.4
5	4.7	55	5.1	105	5.6	155	9.2	205	13.6	255	18.3	305	9.3	355	5.4
6	4.7	56	5.1	106	5.9	156	9.2	206	13.8	256	18.3	306	9.3	356	5.1
7	4.7	57	5.1	107	6.4	157	9.1	207	14.0	257	16.5	307	9.5	357	4.9
8	4.6	58	5.1	108	6.5	158	8.9	208	14.2	258	16.3	308	9.9	358	5.0
9	4.6	59	5.1	109	6.5	159	8.7	209	14.4	259	16.3	309	10.0	359	4.8
10	4.5	60	5.4	110	6.5	160	8.8	210	14.6	260	16.1	310	10.3	360	4.7
11	4.4	61	5.5	111	6.6	161	9.1	211	14.8	261	15.8	311	10.4	361	4.7
12	4.3	62	5.7	112	6.6	162	8.8	212	15.0	262	15.6	312	10.4	362	4.7
13	4.2	63	5.8	113	6.8	163	9.3	213	15.2	263	15.5	313	10.5	363	4.6
14	4.0	64	5.7	114	6.8	164	9.6	214	15.3	264	15.5	314	10.5	364	4.6
15	3.9	65	5.8	115	6.6	165	9.4	215	15.4	265	15.7	315	10.5	365	4.6
16	3.8	66	5.9	116	6.8	166	9.3	216	15.5	266	15.7	316	10.0		
17	3.8	67	6.0	117	7.1	167	9.3	217	15.6	267	15.7	317	9.9		
18	3.8	68	6.3	118	7.3	168	9.4	218	15.8	268	15.6	318	9.8		
19	3.7	69	6.3	119	7.3	169	9.5	219	15.9	269	15.3	319	9.7		
20	3.7	70	6.2	120	7.3	170	9.4	220	16.2	270	15.2	320	9.7		
21	3.6	71	6.2	121	7.2	171	10.2	221	16.3	271	14.9	321	9.2		
22	3.6	72	6.2	122	7.0	172	11.1	222	16.4	272	14.8	322	7.3		
23	3.7	73	6.0	123	7.1	173	10.0	223	16.5	273	14.8	323	6.7		
24	3.8	74	6.0	124	7.3	174	10.2	224	16.7	274	16.9	324	7.0		
25	3.8	75	5.8	125	7.7	175	10.2	225	16.8	275	16.8	325	6.7		
26	3.8	76	5.8	126	7.4	176	10.4	226	16.9	276	16.5	326	6.6		
27	3.8	77	5.8	127	7.4	177	10.6	227	17.0	277	16.4	327	6.8		
28	3.8	78	5.7	128	7.2	178	10.7	228	17.2	278	16.3	328	6.4		
29	3.8	79	5.7	129	7.3	179	10.8	229	17.3	279	16.0	329	6.1		
30	3.7	80	5.6	130	7.8	180	10.8	230	17.5	280	13.1	330	6.2		
31	3.7	81	5.8	131	8.0	181	10.9	231	17.6	281	12.9	331	6.4		
32	3.6	82	6.1	132	8.1	182	11.0	232	17.8	282	12.7	332	6.5		
33	3.6	83	6.2	133	8.2	183	11.1	233	18.1	283	12.4	333	6.4		
34	3.6	84	6.4	134	8.4	184	11.1	234	18.2	284	12.2	334	6.2		
35	3.6	85	6.2	135	8.2	185	11.1	235	18.4	285	12.1	335	6.1		
36	3.5	86	6.2	136	8.2	186	11.2	236	18.6	286	11.9	336	6.0		
37	3.5	87	6.0	137	8.3	187	11.3	237	18.8	287	7.4	337	6.0		
38	3.5	88	5.9	138	8.1	188	11.3	238	18.8	288	7.6	338	6.2		
39	3.5	89	5.7	139	8.2	189	11.4	239	19.0	289	7.7	339	6.4		
40	3.4	90	5.7	140	8.7	190	11.5	240	19.0	290	7.8	340	6.0		
41	3.4	91	5.5	141	8.8	191	11.6	241	19.1	291	8.0	341	5.6		
42	3.4	92	5.4	142	8.5	192	11.7	242	19.2	292	8.1	342	5.2		
43	3.4	93	5.4	143	8.3	193	11.8	243	19.2	293	8.3	343	5.1		
44	3.7	94	5.4	144	8.6	194	11.9	244	19.3	294	8.4	344	5.0		
45	4.4	95	5.4	145	8.7	195	12.1	245	19.4	295	8.6	345	4.9		
46	5.0	96	5.3	146	8.4	196	12.3	246	18.6	296	8.8	346	4.9		
47	4.8	97	5.3	147	8.5	197	12.4	247	18.6	297	9.0	347	4.9		
48	4.7	98	5.4	148	9.5	198	12.5	248	18.7	298	9.3	348	5.1		
49	4.5	99	5.4	149	9.6	199	12.6	249	18.7	299	9.5	349	5.1		
50	4.4	100	5.4	150	9.4	200	12.7	250	18.8	300	9.6	350	5.6 1		

ANONYMOUS RESERVOIR EXAMPLE INPUT DATA
1992 - HYDROLOGY
1992 - METEOROLOGY

*** RELEASE QUALITY (MG/L) ***

1	25.3	51	32.8	101	6.0	151	3.3	201	2.3	251	2.0	301	1.9	351	78.8
2	20.8	52	51.8	102	9.6	152	3.2	202	2.3	252	2.0	302	3.3	352	71.3
3	22.5	53	44.3	103	5.3	153	3.2	203	2.2	253	2.0	303	2.9	353	53.9
4	22.2	54	36.5	104	5.1	154	3.2	204	2.2	254	2.0	304	2.5	354	40.6
5	22.4	55	33.6	105	4.9	155	3.1	205	2.2	255	2.0	305	2.3	355	30.5
6	22.0	56	33.6	106	5.3	156	3.1	206	2.2	256	2.0	306	2.1	356	22.9
7	22.0	57	28.9	107	5.8	157	3.1	207	2.2	257	2.1	307	2.0	357	18.4
8	21.3	58	22.8	108	6.0	158	3.1	208	2.2	258	2.1	308	2.0	358	21.7
9	20.7	59	20.3	109	5.8	159	3.1	209	2.2	259	2.1	309	1.9	359	21.2
10	19.2	60	18.8	110	5.7	160	3.1	210	2.2	260	2.1	310	1.8	360	19.3
11	17.4	61	17.8	111	5.6	161	3.0	211	2.1	261	2.1	311	1.8	361	19.5
12	15.1	62	15.5	112	5.4	162	3.0	212	2.1	262	2.1	312	1.8	362	19.5
13	12.3	63	15.2	113	5.3	163	2.9	213	2.1	263	2.1	313	1.7	363	19.8
14	9.9	64	16.4	114	5.2	164	2.9	214	2.1	264	2.1	314	1.7	364	19.5
15	7.4	65	16.4	115	4.9	165	2.9	215	2.1	265	2.1	315	1.7	365	19.2
16	5.4	66	12.1	116	4.8	166	2.9	216	2.1	266	2.0	316	1.8		
17	3.9	67	11.8	117	4.8	167	2.9	217	2.1	267	2.0	317	1.7		
18	3.0	68	11.0	118	4.7	168	2.9	218	2.1	268	2.0	318	1.7		
19	2.4	69	10.8	119	4.7	169	2.8	219	2.1	269	2.0	319	1.7		
20	2.2	70	13.2	120	4.6	170	2.9	220	2.1	270	2.0	320	1.6		
21	1.9	71	9.7	121	4.7	171	2.7	221	2.1	271	2.0	321	2.5		
22	1.9	72	9.3	122	4.6	172	2.6	222	2.1	272	2.0	322	4.1		
23	1.5	73	8.9	123	4.5	173	2.8	223	2.0	273	2.0	323	3.2		
24	1.5	74	8.9	124	4.4	174	2.7	224	2.0	274	1.9	324	2.4		
25	1.5	75	8.8	125	4.3	175	2.7	225	2.1	275	1.9	325	2.1		
26	1.9	76	8.7	126	4.4	176	2.7	226	2.0	276	1.8	326	1.8		
27	1.7	77	8.3	127	4.4	177	2.6	227	2.0	277	1.9	327	1.7		
28	1.6	78	7.8	128	4.4	178	2.6	228	2.0	278	1.9	328	1.5		
29	1.5	79	7.6	129	4.3	179	2.6	229	2.0	279	1.8	329	1.4		
30	1.4	80	7.2	130	4.1	180	2.6	230	2.0	280	8.5	330	1.4		
31	1.4	81	7.3	131	3.9	181	2.6	231	2.0	281	4.6	331	1.5		
32	1.4	82	7.3	132	3.9	182	2.5	232	2.0	282	4.8	332	1.9		
33	1.4	83	7.1	133	3.8	183	2.5	233	2.0	283	4.3	333	2.7		
34	1.5	84	7.0	134	3.8	184	2.5	234	2.0	284	4.0	334	2.0		
35	1.5	85	6.7	135	4.0	185	2.5	235	2.0	285	3.6	335	2.0		
36	1.5	86	6.7	136	4.0	186	2.5	236	2.0	286	3.4	336	1.6		
37	1.6	87	6.4	137	3.8	187	2.5	237	2.0	287	4.6	337	1.6		
38	1.6	88	6.3	138	3.9	188	2.4	238	2.0	288	4.0	338	2.8		
39	1.6	89	6.1	139	3.8	189	2.4	239	2.1	289	4.0	339	2.5		
40	1.6	90	6.1	140	3.6	190	2.4	240	2.1	290	3.8	340	2.1		
41	1.6	91	5.9	141	3.5	191	2.4	241	2.1	291	3.8	341	1.7		
42	1.6	92	5.8	142	3.7	192	2.4	242	2.1	292	3.7	342	1.6		
43	1.6	93	5.7	143	3.6	193	2.4	243	2.1	293	3.6	343	1.4		
44	8.2	94	5.5	144	3.5	194	2.4	244	2.1	294	3.5	344	1.4		
45	48.4	95	5.4	145	3.6	195	2.3	245	2.1	295	3.4	345	1.3		
46	80.6	96	5.2	146	3.7	196	2.3	246	2.0	296	3.2	346	1.3		
47	66.3	97	5.0	147	3.7	197	2.3	247	2.0	297	3.1	347	1.3		
48	58.8	98	4.9	148	3.5	198	2.3	248	2.0	298	2.8	348	1.2		
49	52.6	99	4.7	149	3.4	199	2.3	249	2.0	299	2.5	349	15.3		
50	43.3	100	4.8	150	3.4	200	2.3	250	2.0	300	2.1	350	96.6		

APPENDIX G: EXAMPLE PLOTTING OUTPUT FILE

Note: This plotting file corresponds to the output file shown in Appendix F.

EXAMPLE PLOTTING OUTPUT FILE

```
ANONYMOUS RESERVOIR EXAMPLE INPUT DATA                              PROFILES
DEPTH          240.
DATE       28 APR 1992
DATE       **
POINTS            53
       .000      4.722      7.612
      6.000      4.722      7.612
     10.000      4.745      7.734
     14.000      4.791      4.450
     18.000      4.791      4.450
     22.000      4.791      4.450
     26.000      4.848      4.237
     30.000      4.848      4.237
     34.000      4.859      2.977
     38.000      4.933      4.482
     42.000      4.933      4.482
     46.000      4.977      4.094
     50.000      4.977      4.094
     54.000      5.025      3.954
     58.000      5.070      4.391
     62.000      5.107      4.398
     66.000      5.198      5.443
     70.000      5.172      4.006
     74.000      5.263      5.209
     78.000      5.355      5.338
     82.000      5.356      5.334
     86.000      5.432      4.753
     90.000      5.538      5.595
     94.000      5.545      5.585
     98.000      5.703      5.383
    102.000      5.716      5.433
    106.000      5.845      5.842
    110.000      5.923      5.477
    114.000      5.959      4.943
    118.000      6.118      5.238
    122.000      6.158      5.188
    126.000      6.298      5.080
    130.000      6.379      5.270
    134.000      6.479      4.981
    138.000      6.607      5.095
    142.000      6.705      5.251
    146.000      6.835      4.920
    150.000      6.967      5.171
    154.000      7.108      4.888
    158.000      7.265      4.781
    162.000      7.430      4.502
    166.000      7.594      4.117
    170.000      7.757      3.875
    174.000      7.907      3.570
    178.000      8.068      3.409
    182.000      8.273      3.512
    186.000      8.597      4.096
    190.000      9.167      4.631
    194.000     10.006      5.174
    198.000     10.868      5.649
    202.000     10.868      5.649
    206.000     10.868      5.649
    211.068     10.868      5.649
  PROFILES
  DATE        2 JUN 1992
  DATE       **
  POINTS            53
         .000      5.639      8.930
        6.000      5.639      8.930
       10.000      5.639      8.930
       14.000      5.774      4.774
```

18.000	5.774	4.774
22.000	5.774	4.774
26.000	5.823	2.226
30.000	5.896	3.712
34.000	5.896	3.712
38.000	5.946	4.353
42.000	6.021	4.547
46.000	6.021	4.547
50.000	6.171	5.084
54.000	6.171	5.084
58.000	6.331	7.176
62.000	6.338	4.918
66.000	6.338	4.918
70.000	6.542	4.723
74.000	6.542	4.723
78.000	6.775	4.873
82.000	6.775	4.873
86.000	6.932	5.422
90.000	7.003	3.885
94.000	7.137	4.523
98.000	7.284	4.133
102.000	7.444	4.111
106.000	7.617	3.803
110.000	7.800	3.750
114.000	7.975	3.431
118.000	8.150	3.354
122.000	8.321	3.264
126.000	8.485	3.139
130.000	8.648	3.087
134.000	8.804	2.966
138.000	8.965	2.936
142.000	9.128	2.891
146.000	9.290	2.857
150.000	9.460	2.894
154.000	9.626	2.943
158.000	9.805	3.018
162.000	9.992	2.948
166.000	10.172	2.642
170.000	10.358	2.767
174.000	10.597	2.751
178.000	10.911	2.795
182.000	11.375	3.020
186.000	12.073	3.206
190.000	13.059	3.313
194.000	14.274	3.361
198.000	15.409	3.379
202.000	15.410	3.379
206.000	15.409	3.379
211.371	15.410	3.379

PROFILES
DATE 21 JUL 1992
DATE **
POINTS 53

.000	5.748	75.641
6.000	5.748	75.641
10.000	5.760	29.098
14.000	5.813	12.043
18.000	5.810	8.180
22.000	6.048	2.940
26.000	6.048	2.940
30.000	6.048	2.940
34.000	6.283	3.923
38.000	6.283	3.923
42.000	6.283	3.923
46.000	6.496	4.711
50.000	6.496	4.711
54.000	6.733	4.779
58.000	6.733	4.779
62.000	6.733	4.779
66.000	7.015	4.670
70.000	7.015	4.670
74.000	7.302	4.385

78.000	7.302	4.385
82.000	7.488	4.438
86.000	7.562	4.013
90.000	7.791	3.933
94.000	7.791	3.933
98.000	7.925	3.652
102.000	8.003	3.619
106.000	8.485	3.159
110.000	9.119	2.820
114.000	9.646	2.686
118.000	10.116	2.626
122.000	10.524	2.580
126.000	10.883	2.534
130.000	11.221	2.487
134.000	11.531	2.439
138.000	11.858	2.380
142.000	12.195	2.305
146.000	12.548	2.206
150.000	12.931	2.076
154.000	13.293	1.939
158.000	13.656	1.812
162.000	14.016	1.724
166.000	14.414	1.674
170.000	14.929	1.663
174.000	15.563	1.702
178.000	16.372	1.760
182.000	17.361	1.840
186.000	18.520	1.887
190.000	20.064	2.205
194.000	21.925	2.441
198.000	22.751	2.609
202.000	22.751	2.609
206.000	22.751	2.609
208.760	22.751	2.609

PROFILES
DATE 10 SEP 1992
DATE **
POINTS 48

.000	5.750	81.314
6.000	5.750	81.314
10.000	5.760	29.526
14.000	5.859	16.476
18.000	5.899	14.652
22.000	6.198	11.194
26.000	6.183	8.016
30.000	6.481	5.910
34.000	6.481	5.910
38.000	6.587	4.516
42.000	6.722	4.319
46.000	6.722	4.319
50.000	6.965	4.336
54.000	6.965	4.336
58.000	7.074	4.124
62.000	7.224	4.150
66.000	7.232	3.837
70.000	7.488	4.049
74.000	7.501	3.828
78.000	7.689	3.837
82.000	7.761	3.894
86.000	7.982	3.545
90.000	8.001	3.774
94.000	8.136	3.399
98.000	8.243	3.377
102.000	8.373	3.365
106.000	8.506	3.148
110.000	9.308	2.779
114.000	10.251	2.608
118.000	11.178	2.474
122.000	11.848	2.352
126.000	12.300	2.248
130.000	12.655	2.153
134.000	12.955	2.066

138.000	13.272	1.974
142.000	13.603	1.887
146.000	13.962	1.810
150.000	14.405	1.746
154.000	14.945	1.696
158.000	15.699	1.604
162.000	16.775	1.468
166.000	18.180	1.499
170.000	20.139	1.696
174.000	21.951	2.158
178.000	21.951	2.158
182.000	21.951	2.158
186.000	21.951	2.158
190.821	21.951	2.158

PROFILES
DATE 20 OCT 1992
DATE **
POINTS 39

.000	7.882	2.852
6.000	7.987	2.569
10.000	8.043	3.887
14.000	8.112	3.777
18.000	8.171	3.719
22.000	8.224	3.662
26.000	8.275	3.460
30.000	8.331	3.445
34.000	8.384	3.469
38.000	8.451	3.416
42.000	8.521	3.358
46.000	8.594	3.315
50.000	8.683	3.232
54.000	8.774	3.158
58.000	8.891	3.095
62.000	9.027	2.961
66.000	9.187	2.810
70.000	9.396	2.647
74.000	9.625	2.481
78.000	9.904	2.304
82.000	10.202	2.124
86.000	10.510	1.975
90.000	10.856	1.898
94.000	11.197	1.826
98.000	11.569	1.755
102.000	11.933	1.725
106.000	12.289	1.727
110.000	12.666	1.741
114.000	13.037	1.751
118.000	13.449	1.753
122.000	13.875	1.751
126.000	14.286	1.755
130.000	14.634	1.776
134.000	14.796	1.808
138.000	14.796	1.808
142.000	14.796	1.808
146.000	14.796	1.808
150.000	14.796	1.808
154.807	14.796	1.808

RELEASE VALUES
SIMULATION 1 365
YEAR 1992
YEAR 1992

5.211	4.746	4.778	4.736	4.729	4.693	4.684	4.639	4.601	4.525	4.434
4.320	4.167	4.030	3.887	3.808	3.798	3.753	3.696	3.663	3.613	3.564
3.710	3.763	3.768	3.817	3.769	3.792	3.763	3.723	3.683	3.646	3.619
3.590	3.555	3.530	3.512	3.489	3.468	3.450	3.431	3.415	3.395	3.706
4.406	5.027	4.793	4.659	4.539	4.405	4.469	5.158	5.236	5.119	5.087
5.085	5.063	5.057	5.113	5.373	5.501	5.719	5.778	5.732	5.768	5.866
5.968	6.300	6.283	6.249	6.247	6.186	6.031	5.970	5.846	5.825	5.759
5.706	5.703	5.641	5.836	6.050	6.242	6.444	6.163	6.189	6.041	5.920
5.741	5.686	5.455	5.422	5.386	5.375	5.357	5.344	5.339	5.376	5.399
5.444	5.479	5.661	5.674	5.647	5.621	5.923	6.351	6.539	6.469	6.491
6.560	6.591	6.789	6.795	6.583	6.788	7.059	7.310	7.258	7.284	7.155

7.011	7.088	7.325	7.687	7.428	7.366	7.212	7.319	7.809	8.041	8.062
8.232	8.375	8.203	8.190	8.335	8.091	8.161	8.654	8.829	8.484	8.285
8.593	8.706	8.423	8.536	9.458	9.574	9.433	9.374	9.331	9.398	9.217
9.168	9.200	9.067	8.856	8.750	8.819	9.110	8.754	9.282	9.566	9.439
9.267	9.325	9.391	9.480	9.427	10.207	11.088	10.014	10.205	10.234	10.423
10.613	10.737	10.752	10.762	10.904	11.016	11.104	11.147	11.078	11.205	11.283
11.321	11.391	11.491	11.592	11.701	11.819	11.931	12.085	12.267	12.394	12.519
12.645	12.721	12.879	13.048	13.226	13.375	13.595	13.779	13.981	14.192	14.392
14.635	14.819	14.996	15.165	15.292	15.381	15.476	15.630	15.814	15.938	16.155
16.299	16.384	16.515	16.681	16.817	16.926	17.008	17.177	17.335	17.491	17.621
17.822	18.051	18.181	18.403	18.615	18.762	18.771	18.956	18.962	19.072	19.163
19.158	19.297	19.441	18.574	18.617	18.681	18.671	18.755	18.781	18.719	18.682
18.645	18.309	18.314	16.506	16.331	16.265	16.090	15.775	15.624	15.540	15.503
15.650	15.680	15.713	15.600	15.347	15.182	14.920	14.834	14.779	16.920	16.750
16.508	16.422	16.317	15.966	13.089	12.890	12.651	12.359	12.211	12.080	11.851
7.401	7.569	7.706	7.844	7.983	8.127	8.276	8.432	8.615	8.810	9.022
9.291	9.544	9.573	9.604	9.473	9.547	9.296	9.327	9.268	9.466	9.860
10.049	10.303	10.379	10.441	10.523	10.543	10.483	10.033	9.929	9.789	9.688
9.692	9.172	7.344	6.748	6.998	6.736	6.637	6.753	6.350	6.070	6.178
6.438	6.546	6.374	6.229	6.034	5.978	6.023	6.167	6.383	6.020	5.552
5.155	5.053	5.044	4.922	4.887	4.948	5.072	5.085	5.607	5.465	5.504
5.545	5.371	5.390	5.101	4.947	5.030	4.840	4.678	4.658	4.658	4.650
4.633	4.604									
QUALITY	1									
25.282	20.843	22.549	22.150	22.443	22.021	22.013	21.276	20.695	19.212	17.357
15.131	12.340	9.949	7.436	5.437	3.944	3.019	2.358	2.167	1.941	1.884
1.547	1.482	1.460	1.864	1.745	1.586	1.504	1.430	1.420	1.410	1.427
1.476	1.510	1.528	1.585	1.623	1.638	1.644	1.641	1.643	1.637	8.210
48.433	80.555	66.259	58.798	52.621	43.259	32.753	51.777	44.254	36.511	33.583
33.608	28.921	22.775	20.334	18.756	17.831	15.456	15.180	16.436	16.427	12.074
11.784	10.973	10.811	13.209	9.699	9.251	8.909	8.858	8.750	8.719	8.298
7.815	7.584	7.155	7.290	7.302	7.096	7.038	6.740	6.696	6.377	6.267
6.109	6.085	5.920	5.817	5.675	5.493	5.356	5.243	5.043	4.863	4.699
4.764	5.979	9.610	5.261	5.124	4.942	5.313	5.826	5.990	5.838	5.703
5.595	5.442	5.259	5.163	4.909	4.819	4.772	4.699	4.689	4.631	4.650
4.614	4.494	4.415	4.296	4.395	4.395	4.365	4.255	4.083	3.928	3.895
3.823	3.782	3.994	3.981	3.834	3.911	3.784	3.576	3.509	3.665	3.636
3.543	3.621	3.740	3.726	3.451	3.394	3.354	3.304	3.244	3.220	3.189
3.149	3.104	3.095	3.090	3.086	3.051	2.995	3.031	2.938	2.873	2.876
2.896	2.877	2.865	2.841	2.850	2.725	2.649	2.752	2.707	2.695	2.672
2.636	2.604	2.615	2.589	2.582	2.538	2.507	2.502	2.502	2.473	2.455
2.443	2.428	2.410	2.395	2.380	2.367	2.353	2.336	2.325	2.308	2.293
2.284	2.282	2.269	2.257	2.241	2.227	2.206	2.195	2.184	2.173	2.165
2.151	2.142	2.131	2.128	2.117	2.106	2.101	2.092	2.085	2.078	2.073
2.061	2.052	2.040	2.048	2.050	2.048	2.050	2.047	2.046	2.048	2.048
2.046	2.042	2.042	2.049	2.045	2.043	2.049	2.062	2.065	2.083	2.089
2.089	2.091	2.090	2.018	2.018	2.017	2.016	2.013	1.991	1.991	1.999
2.001	1.988	1.989	2.106	2.113	2.112	2.106	2.092	2.096	2.085	2.081
2.063	2.046	2.038	2.029	2.015	1.995	1.985	1.968	1.957	1.866	1.852
1.845	1.854	1.851	1.841	8.544	4.634	4.769	4.309	3.972	3.642	3.413
4.584	3.957	4.021	3.818	3.774	3.679	3.605	3.519	3.381	3.237	3.077
2.841	2.506	2.071	1.897	3.259	2.851	2.464	2.291	2.088	2.036	1.979
1.870	1.816	1.796	1.763	1.728	1.715	1.653	1.778	1.706	1.700	1.694
1.650	2.509	4.106	3.150	2.385	2.073	1.841	1.674	1.523	1.405	1.379
1.480	1.859	2.678	2.032	1.997	1.639	1.563	2.806	2.499	2.056	1.671
1.605	1.448	1.445	1.336	1.260	1.275	1.199	15.276	96.597	78.824	71.261
53.872	40.555	30.507	22.854	18.449	21.657	21.187	19.302	19.525	19.518	19.816
19.529	19.178									

APPENDIX H: ERROR CODES

1. If the WESTEX model encounters conditions in the execution of the program or the reading of the input data that indicate an error, the execution of the program will terminate. The WESTEX model uses error codes to identify where the problem was located when the program had to stop.

2. The first set of error codes corresponds to problems encountered in reading model input. As explained in the description of the input data, the normal input line format is the name of the variable to be read, followed by its values. The model reads these variable names to ensure that the input is in the proper sequence. If the program does not find the variable it was expecting to read, it will stop and print an error code, for example, STOP 1000. Table H1 lists the error code and the variable the program was expecting to read when the problem occurred.

3. The second set of error codes corresponds to problems encountered in model execution. These are errors that normally should not occur. If one of these errors is encountered and the solution to the problem is not obvious, it is suggested that the user contact the Reservcir Water Quality Branch, WES, to discuss the problem. The user should be prepared to provide WES with the error code number encountered and a description of the reservoir being analyzed. Table H2 lists the error code and the subprogram in which the problem occurred.

Table H1

Error Codes Associated with Input Data

ERROR CODE NO.	VARIABLE EXPECTED	INPUT OR INPUT GROUP NO.
1000	FILES	2
1010	PREDICTION/VERIFICATION	5
1020	INFLOWS	7
1030	LAYERS	8
1040	THICKNESS	9
1050	BOTTOM	10
1060	VOLUME	11
1070	WIDTH	13
1080	PORTS	15
1090	AREA	16
1091	ANGLE	17
1100	HEIGHT	18
1110	MINIMUM	19
1120	MAXIMUM	20
1130	WETWELL	21
1140	SELMAX	22
1150	FLOODGATE	23
1160	WEIR	15
1170	FREE/SUBMERGED	16
1180	COEFFICIENT	19
1190	HEAT	24
1195	MIXING	25
1197	ENTRAINMENT	26
1240	INTERVAL	29
1250	SIMULATE	30
1260	PRINT DAYS	31
1270	TARGET TEMPERATURES	32
1280	FAHRENHEIT/CELSIUS	32
1290	DEPTH	34
1300	TEMPERATURE – INITIAL	35
1310	FAHRENHEIT/CELSIUS	35
1320	QUALITIES	37
1330	EQUILIBRIUM TEMPERATURE	39
1340	EXCHANGE COEFFICIENTS	41
1350	SHORTWAVE SOLAR RADIATION	43
1355	WIND SPEED	45
1360	INFLOW QUANTITY	47
1370	KACF/CFS	47
1380	INFLOW TEMPERATURE	49
1390	FAHRENHEIT/CELSIUS	49

(Continued)

Table H1 (Concluded)

ERROR CODE NO.	VARIABLE EXPECTED	INPUT OR INPUT GROUP NO.
1400	INFLOW QUALITIES	51
1410	OUTFLOW QUANTITY - PREDICTION	53
1420	KACF/CFS	53
1430	OUTFLOW QUANTITY - VERIFICATION	53
1440	KACF/CFS	53
1450	WEIR FLOW	53
1460	KACF/CFS	53

Table H2

Error Codes Associated with Program Execution

Error Code No.	Subprogram Location	Brief Description
999	RELEASE	Exceeding maximum number of layers specified
2000	HEATEX	Problem in calculating thickness of the top layer
2020	INFLOW	Exceeding maximum number of layers specified
2040	VPORT	Half-interval search for limits of withdrawal will not converge
2060	VWEIR	Problem in calculating limits of withdrawal
2070	VWEIR	Half-interval search for limits of withdrawal will not converge

APPENDIX I: NOTATION

A	Horizontal cross-sectional area, ft^2
A_g	Area of mud-water interface, ft^2
A_s	Surface area of lake, ft^2
C	Concentration of conservative constituent, mg/l
C_i	Inflow concentration, mg/l
C_j	Concentration of water quality constituent, mg/l
C_o	Outflow concentration, mg/l
C_p	Specific heat of water at constant pressure, BTU/lb/day
e	Natural logarithmic base (2.7183)
E	Equilibrium temperature, °F
h	Distance below mud-water interface, ft
H_a	Long-wave radiation, Btu/ft^2/day
H_{ar}	Reflected long-wave radiation, Btu/ft^2/day
H_{br}	Back radiation water surface, Btu/ft^2/day
H_c	Heat transfer by conduction, Btu/ft^2/day
H_e	Heat loss by evaporation, Btu/ft^2/day
H_g	Rate of heat transfer through the ground, Btu/ft^2/day
H_i	Heat added by inflow, Btu/day
H_{in}	Heat added into control volume, Btu/day
H_n	Net heat transfer at the air-water interface, Btu/ft^2/day
$H_{n,a}$	Net rate of advected heat, Btu/day
H_o	Heat extracted by outflow, Btu/day
H_{out}	Heat extracted from control volume, Btu/day
H_s	Short-wave solar radiation arriving at the water surface, Btu/ft^2/day
$H_{s\ell}$	Heat transfer flux into the surface layer, Btu/ft^2/day
H_{sr}	Reflected short wave radiation, Btu/ft^2/day
H_{Z_i}	Heat transfer flux passing through plane at depth Z_i, Btu/ft^2
j	Index for quality constituent
k	Vertical diffusion coefficient, ft^2/day
K	Surface heat exchange coefficient, Btu/ft^2/day/°F
K_g	Thermal conductivity of the bottom mud, Btu/ft/day/°F
N	Number of water quality constituents excluding temperature
q_i	Rate of inflow, ft^3/day
q_o	Rate of outflow, ft^3/day
Q_i	Flow into control volume or layer, ft^3/day

Q_o	Flow out of control volume, ft^3/day
Q_v	Net vertical flow out of layer, ft^3/day
S_j	Specific weight of constituent
t	Time, days
V	Volume of lake, ft^3
Z	Elevation, ft
Z_i	Depth below surface at midpoint of layer i, ft
β	Short-wave radiation absorbed into upper 2 ft, percent
ΔH	Net heat of control volume, Btu/day
Δt	Time increment, days
ΔZ	Layer thickness, ft
$\Delta\theta$	Average temperature change during time interval, °F
η	Heat absorption coefficient, ft^{-1}
θ	Temperature of water, °C
θ_h	Temperature of mud at h ft below mud-water interface, °F
θ_i	Inflow water temperature, °F
θ_o	Outflow water temperature, °F
θ_g	Water temperature at the mud-water interface, °F
θ_s	Water surface temperature, °F
ρ	Density of water, g/ml
ψ	Total incoming short-wave radiation flux, Btu/ft^2/day
$\frac{\partial H}{\partial Z}$	External heat source, Btu/ft/day

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WESTEX is a numerical, one-dimensional reservoir thermal model developed at the US Army Engineer Waterways Experiment Station. This report was developed to assist users of the WESTEX computer model. The report discusses the concepts of thermal stratification in reservoirs and describes how those concepts are implemented in the WESTEX model. The report provides an overview of the execution of the WESTEX model and includes guidance on preparing the required input data for the model. Examples of model input and model output are provided.

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